Introduction The World Health Organisation has ranked environmental exposures among the top risk factors for chronic disease mortality. Worldwide 55 million people die each year from non-communicable diseases (NCD) including cancer, diabetes, chronic cardiovascular, respiratory, and neurological diseases.

Methods The EU-funded project Diagnosis, Monitoring and Prevention of Exposure Related Non-Communicable Diseases (DiMoPEX) aims at developing new concepts for a better understanding of health-environment (including gene-environment) interactions in the aetiology of NCDs. The project is advancing within several working groups, which cover the areas of exposure assessment, toxicology, epidemiology, ethical issues, biomarkers of genetic effects and epigenetic and clinical characteristics of NCDs.

Results DiMoPEX partners have identified some of the emerging research needs, including evidence-based exposure data, animal models reflecting total human life-span and low dose cumulative exposures. From the perspective of epidemiology the gaps between risk factor and health outcome may be bridged by biomarker-based research in which well-designed experimental exposure studies and biomarkers of early response should play a central role. DiMoPEX identified several drawbacks in existing studies on exposure-NCD association, e.g. inappropriate study design or suboptimal patient recruitment and sample collection as well as poor data interpretation. As a consequence such studies sometimes do not provide results of desired quality. In occupational and environmental health the use of biomarkers is embedded in a process called human biological monitoring with its standard performance rules. Studies addressing health outcomes in relation to exposures in the living and working environment often do not sufficiently account for existing knowledge regarding proper exposure measures in their study design (e.g. recording only ever/never exposed or self-reporting of chemicals which can lead to exposure misclassification).

Discussion DiMoPEX will focus on closing the gap between exposure and disease by extracting and organising evidence-base exposure data, which may support the diagnosis and prevention of NCDs.

1302 DEVELOPMENT OF A PORTABLE ANALYZER FOR ON-SITE BIOMONITORING OF WORKERS EXPOSED TO RESPIRABLE CRYSTALLINE SILICA

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10.1136/oemed-2018-ICOHabstracts.1137

Introduction Respirable crystalline silica (RCS) exposure is considered as one of the most significant occupational health problems in the United States. Recent National Institute for Occupational Safety and Health (NIOSH) field studies identified overexposure to RCS in oil and gas extraction workers, with exposures exceeding occupational RCS exposure levels by factors of 20 or more in sand moving and transfer belt operations. To facilitate on-site screening of workers to identify early (i.e., preclinical) biological responses to RCS exposure, there is a strong need for field-portable diagnostic instruments and methods, particularly for workers in mining, oil and gas extraction, and construction industries.

Methods A portable analyzer for on-site biomonitoring using a lab-on-a-chip (LOC) device was developed, and its performance in measurement of an inflammatory biomarker for inhalation of RCS aerosol was evaluated.

Results The overall performance of the portable analyzer with the LOC device had accuracy and precision comparable to laboratory testing results. It runs on a LabView-based program that controls variable parameters: on/off sequence, reagent flow speed, pump run time and optical detection. The pump input to the LOC and a portable analyzer are coupled to the LOC device with PEEK tubing, for automated ELISA testing in the field.

Conclusion This is the first field-portable analyzer capable of on-site screening of workers to identify early (i.e., preclinical) biological responses to RCS exposure. Our work supports application of the analyzer together with the developed LOC as a portable monitor for on-site detection of lung inflammation in workers exposed to RCS, with minimum user intervention. Development of a device for detecting exposure-related biomarkers of biological processes (e.g., inflammation) that are predictive of the pathogenicity of exposure to RCS and other airborne toxicants would offer an important new approach for silicosis prevention.

1400 BENZENE EXPOSURE AND HUMAN HEALTH RISK ASSESSMENT VIA BIOLOGICAL MONITORING AMONG WORKERS AT GASOLINE STATIONS

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10.1136/oemed-2018-ICOHabstracts.1138

Introduction A low benzene concentrations in working environment at gasoline stations has been reported with a concern as human carcinogen. Trans, trans-Muconic acid (tt-MA), a metabolite widely used biomarker, is suggested for detection of low benzene exposure. This study aimed to investigate health risk on benzene exposure via biomarker detection and inhaled benzene concentration among gasoline station workers. **Methods** The study was conducted among 235 gasoline station workers in Thailand. Spot urine was collected from workers at the end of shift-work and analysed for tt-MA concentration using HPLC. Benzene concentration was measured by personal air sampling and analysed using GC-FID. Additional data was collected by questionnaires and observations. Health risk assessment was performed with applied 5 × 5 risk matrix considering the likelihood of exposure frequency (t,t-MA and benzene level) and severity of adverse symptoms related to benzene toxicity.

Results Gasoline station workers (85.11%) had experiences of adverse symptoms from mild to severe level. Urinary t,t-MA was detected in 73.62% of workers whereas only 9.25% of them had tt-MA higher than the recommended value (>500 µg/g Creatinine). The risk matrix using tt-MA levels identified worker's health risk was unacceptable levels (low to high risk; 69.79%). Considering the matrix using benzene concentration which was presented at lower than the occupational exposure level (<0.1 ppm), 65.53% of workers had health risk from that exposure concentration. This semi-quantitative risk assessment showed the significant correlation to the human health

risk assessment on benzene exposure following inhalation scenario assessment of U.S.EPA. Those workers (70.67%) had potential lifetime cancer risk higher than acceptable level ($>IUR; 2.20E-6$).

Conclusion The finding risk matrix is useful in occupational health surveillance program at gasoline station and for risk control identification. Annual health check-up, monitoring of biomarkers and benzene concentration, and risk communication are necessary to prevent workers adverse health effects and cancer.

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QUANTITATIVE INHALATION EXPOSURE ASSESSMENT ON AIRBORNE PARAQUAT EXPOSURE OF HERBICIDE KNAPSACK SPRAYERS

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10.1136/oemed-2018-ICOHabstracts.1139

Introduction Paraquat is hazardous chemical, widely used as herbicide, and was imported for 31 552 tons to Thailand in 2016. However, there was almost no report of inhalation risk assessment in Thailand. This cross-sectional analytic study was designed to quantify the inhalation exposure to airborne paraquat during spray operation of knapsack sprayers.

Methods The study was conducted in 30 voluntary herbicide knapsack sprayers in a District of Khon Kaen province, Thailand. The airborne paraquat concentration, working and personal characteristics of sprayers were used for inhalation intake calculation following U.S. EPA (1991) equation. The selected concentration of airborne paraquat was from monitoring with active personal sampling using PTFE filter membrane and analysed with HPLC.

Results The paraquat knapsack sprayers were farmers in sugarcane, cassava, rice, and corn field. Paraquat dichloride was used at 0.1–2400 litres/year. Adverse symptoms related to respiratory system were throat/upper airway irritation, runny nose (not from flu), wheezing, and difficulty breathing. The inhalation intake of paraquat exposure in short term effect, long term effect, and specific effect of lung (chronic pneumonitis) were calculated by using paraquat concentration at 125.49 $\mu\text{g}/\text{m}^3$. The intake estimations were between 0.00011 to 0.04610 mg/kg/day. The health risk was presented by hazard quotient ($HQ>1$). $HQ_{\text{long term}}$ was 0.263–115.25 when compared to recommended $AOEL_{\text{long term}}$ (0.0004 mg/kg/day). $HQ_{\text{short term}}$ was 0.211–92.202 when compared to recommended $AOEL_{\text{short term}}$ (0.0005 mg/kg/day). $HQ_{\text{chronic pneumonitis}}$ was 0.023–10.245 when compared to the reference dose (0.0045 mg/kg/day).

Conclusion It can be summarised that at the selected concentration and without using respirator of sprayers, this study found that 66.67%, 63.33% and 13.33% of Thai knapsack sprayers were under unacceptable risk of long term exposure, short term and chronic pneumonitis, respectively. This information should be communicated to the public health related institutes and farmers for seriously preventive regulation on inhalation exposure to paraquat.

1453

URINARY COTININE IN TOBACCO FARMERS IN SOUTHERN BRAZIL

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10.1136/oemed-2018-ICOHabstracts.1140

Introduction High levels of cotinine have been related to the occurrence of green tobacco sickness (GTS), however chronic exposure to nicotine develops tolerance. The objective of this paper is to describe urinary cotinine levels in tobacco farmers.

Methods A cross-sectional study was conducted in 2570 tobacco farmers. All participants that report GTS in the week prior to the interview plus a subsample of 492 pesticide applicators were included. Urinary samples and information about socio-demographic, behavioural, dietary, occupational characteristics and pesticide poisoning during lifetime were collected. Stratification by sex and smoking was performed and Wilcoxon and Kruskal-Wallis non-parametrical tests were used to analyse cotinine means.

Results 582 individuals were analysed. There was no difference in urinary cotinine means between GTS symptomatic and asymptomatic individuals. Among non-smokers, having picked tobacco in the previous week was associated with higher cotinine means in both sexes. Cotinine levels were higher on the first day of symptoms and reduced exponentially with each day in female non-smokers. Male non-smokers had higher levels on the second day and the reduction was more gradual. The cotinine level rose up to 15 cigarettes/day of consumption.

Conclusion The urinary cotinine measures exposure to nicotine up to its saturation point; while GTS, affected by tolerance, indicates nicotine poisoning. Strategies to reduce nicotine exposure in tobacco production are needed. Mechanisation to be used in rough ground and which guarantee leaf quality could be an alternative. More studies are needed to evaluate the chronic effect of nicotine exposure.

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PM10 EXPOSURE AND GENE EXPRESSION MODULATION IN A POPULATION OF HEALTHY STEEL WORKERS

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10.1136/oemed-2018-ICOHabstracts.1141

Introduction The association of gene expressions with exposure to ambient particulate matter (PM) concentrations is still mainly explorative. We took advantage of a study designed to evaluate the short-term association between PM exposure in working environment and biological molecular targets to assess the correlation between PM10 exposure and gene expressions of 44 genes.