nested case-control study was performed to collect individual information concerning classical CSD risk factors (weight, height, smoking status, blood pressure, blood glucose and cholesterolemia) from medical files for 76 cases of death from CSD (including 26 from IHD and 16 from CVD) and 237 controls, matched for attained age and birth date and counter-matched for cumulative radon exposure.

Results In the whole cohort, a significant association with cumulative radon exposure was observed for CVD mortality, but not for CSD or IHD mortality. In the case-control study, no significant unadjusted Odd-Ratio for cumulative radon exposure was observed for any endpoint. Analyses adjusted on CSD risk factors, for which missing data do not exceed 25%, are ongoing.

Conclusions The issue of CSD associated to ionising radiation is crucial for radiation protection. The present study, allowing to consider individual data on major classical CSD risk factors, will contribute to improve knowledge on the effects of low dose exposure.

| 0195 | CARBON NANOTUBE EXPOSURE ASSESSMENT FOR A STUDY ON EARLY BIOLOGICAL EFFECTS; THE CANTES STUDY |

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Objectives To assess personal exposure to carbon nanotubes for a study of early effect biomarkers among workers exposed to carbon nanotubes (CNTs).

Method Three major job categories were identified in the exposed factory: production, R&D and office. For qualitative assessment personal 8-hr-TWA inhalable dust samples (n = 5) were collected in all job categories and analysed by SEM-EDX. For quantitative assessment 8-hr TWA samples (n = 30) were collected from the production and R&D workers and analysed for elemental carbon, corrected for soot using SEM/EDX. Job activities were recorded during all measurements.

Results The qualitative analyses demonstrated the presence of CNTs in the personal breathing zone of production, R&D and office workers. CNT agglomerates with particle sizes between 500 nm and 100 μm were identified for production and R&D workers and between 500 nm and 5 μm for office workers. No single CNTs were identified. The quantitative analyses demonstrated geometric mean (GM) inhalable CNT levels of 42.6 μg/m^3 (min-max: 1.4–1186.5) and 4.6 μg/m^3 (min-max: 0.2–59.5) for the production and R&D workers, respectively.

Conclusions We identified exposure to clusters of CNT in production, R&D and office workers of the CNT production facility. As expected GM exposure was higher for production than for R&D workers, however considerable variability was observed. Additional quantitative measurements in office and production workers are ongoing. For the full set, analyses of within- and between-worker variability and activity as a determinant will be performed. This information will be used to assess personal exposure in a cross-sectional study of early health effects in the CANTES study.

| 0198 | LUNG CANCER RISK AMONG MINNESOTA TACONITE MINING WORKERS |

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Objectives The mining and processing of taconite results in exposures to non-asbestiform amphibole and non-amphibole minerals. Previous studies have shown that taconite mining workers are at an increased risk for developing lung cancer and mesothelioma and duration of employment has been shown to contribute to the risk of mesothelioma incidence. The objective of this analysis is to examine the relationship between duration of employment and lung cancer among Minnesota taconite workers.

Method Among a cohort of 44 243 taconite workers, 1721 cases of lung cancer were identified and matched by five-year age interval to two controls. Total duration of employment was abstracted from individual work records.

Results Among the 5159 workers included in the analysis, 55% worked less than one year and 15% worked 1–5 years, 5–15 years and more than 15 years. The mean duration of employment among cases and controls was 6.7 and 7.2 years respectively. A conditional logistic regression analysis did not show an increased risk for development of lung cancer among those who worked 1–5 years (OR = 1.2, 95% CI: 0.99, 1.38), 5–15 years (OR = 0.94, 95% CI: 0.79, 1.11), and more than 15 years (OR = 0.90, 95% CI: 0.75, 1.08) as compared to those who worked less than one year.

Conclusions Risk for development of lung cancer does not appear to be associated with duration of employment in the taconite industry. Future analyses will explore specific exposures to airborne particulates, including silica and non-asbestiform amphiboles, in this population.

| 0199 | USING MACHINE LEARNING TO EFFICIENTLY USE MULTIPLE EXPERTS TO ASSIGN OCCUPATIONAL LEAD EXPOSURE ESTIMATES IN A CASE-CONTROL STUDY |

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Objectives We applied machine learning approaches to efficiently assist multiple experts to transparently estimate occupational lead exposure in a case-control study of renal cell carcinoma.

Method We used hierarchical cluster models to classify the 7154 study jobs with occupational history and job/industry questionnaires into 360 groups with similar responses. Each group was reviewed independently by two or three experts and was assigned probabilities of lead exposure (<5%, ≥5– <50%, ≥50%) for three time periods (<1980, 1980–1994, ≥1995). When the group's mean response pattern suggested within-group exposure variability, experts identified programmable conditions that defined the rating differences where possible or flagged the group for further review. After splitting jobs that overlapped

time periods at the calendar cut point, the 9992 job/time periods were assigned their relevant expert/group/time period estimate. Classification and regression tree (CART) models were developed to predict each expert's expected assignment, based on previous decisions, to assign estimates for jobs in groups that expert had not assessed and for jobs requiring further review.

Results In preliminary analyses, CART models predicted 91–96% of the experts' pre-1995 estimates and 77–96% of ≥1995 estimates. CART estimates were assigned to 3–48% of the job/time periods, varying by expert. Overall, 92% of the job/time periods were assigned the same estimate by at least two experts.

Conclusions Our framework reduced the number of exposure decisions needed from each expert compared to job-by-job assessment. Future work will use CART models to identify differences between experts to be resolved and incorporate frequency and intensity of lead exposure estimates.

0200 NIGHT SHIFTWORK AND BREAST CANCER SURVIVAL IN DANISH WOMEN

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Objectives There is mounting evidence that night shiftwork may increase the incidence of female breast cancer. The influence of night shift work on survival of breast cancer has, however, not been reported. The aim of the present study is to elucidate breast cancer survival in different types of former non-day shiftworkers compared to day-workers.

Method In total 1157 women (23% nurses), aged less than 75 years, diagnosed with breast cancer (2000–2004) participated in two independent nationwide case-control studies on night shiftwork. Information on the entire work life, including night shiftwork and potential risk factors for breast cancer (e.g. reproduction, BMI, alcohol, HRT, heredity and diurnal preference) was obtained by telephone interviews. All study subjects were followed up for death in the National Cause of Death Register until end of 2011.Cox proportionate hazard models and Kaplan-Meier survival plots were used to perform time-to-event analyses.

Results In total 127 breast cancer cases (11.0%) had died from this disease at end of follow-up (median follow-up 12.6 years). There was a significant tendency of decreasing survival of breast cancer among both fixed and rotating nightshifts workers compared to daytime shiftworkers and by increasing years of prior non-day time work (p = 0.04). Evening workers had about same survival as day workers. The results were only slightly affected by confounders.

Conclusions These data suggest that night shift work prior to breast cancer seems to decrease survival. The association was not strongly modified by lifestyle factors.

0202 THE IMPACT OF RESPIRABLE DUST AND RESPIRABLE QUARTZ ON PULMONARY FUNCTION - RESULTS OF A LONGITUDINAL STUDY

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Objectives The present study sought to examine the long-term effects of exposure to respirable dust, in particular of respirable quartz on pulmonary function.

Method The study is based on the Wismut cohort of former uranium miners. Spirometric data, including forced expiratory volume in 1s (FEV1) and forced vital capacity (FVC) were ascertained together with quantitative estimates of cumulative exposure to respirable dust and respirable quartz for each of the 1421 study subjects born between 1954 and 1956. Linear mixed regression models were fitted to identify significant determinants of longitudinal changes in lung function parameters. Point estimators and confidence intervals for the exposure concentration threshold value were fitted by partial likelihood profiles of the corresponding models.

Results Overall, 7122 data records were included in the analysis - on average five spirometries for each miner. The mean annual exposure concentration to respirable quartz was 0.072 mg/m³. It was shown that cumulative exposure to 1 mg/m³-year respirable quartz leads, on average, to a relative reduction in FEV1 of 2.07% and in the quotient of FEV1/FVC of 2.75% (p < 0.001). The analysis of the whole respirable dust shows, that the fraction of quartz in the dust is the decisive determinant for the impact of dust. A significant improvement of model fit by applying threshold models could not be observed.

Conclusions This study adds further evidence on the long-term effects of exposure to respirable quartz. Current exposure limits for respirable quartz require a critical review.

0203 THE LUNG BURDEN OF ASBESTOS FIBRES (AF) AND ASBESTOS BODIES (AB) AND THE RISK OF MESOTHELIOMA (MM) FOR EXPOSURES CEASED 30 YEARS AGO

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Objectives To estimate the risk of MM according to AF and AB in the lungs.

Method Freeze dried lung samples from 309 MM and 41 controls have been analysed for AF (Scanning Electronic Microscopy) and AB (Optical Microscopy) from subjects investigated and classified for probability and circumstances of asbestos exposure. Odds Ratios (OR) were obtained using logistic regression.

Results 254 (82%) MMs have been classified as occupationally and 25 (8%) as non-occupationally exposed: Geometric Mean (GM) for AF burden was 1 950 000 and 608 000 ff/g dlt, respectively; and 39 300 and 3300 for AB. 75% and 58% of the AF respectively were amphibole.

Controls reported a GM of 269 000 AF and 28 of AB g/dlt.

For any increase of 100.000 ff/g dlt, we computed an OR of 1.7 (1.3–2.3) for amphibole, 1.1 (1.0–1.3) for chrysotile, among occupational MMs; an OR of 1.3 (1.0–1.7) and 1.1 (1.0–1.1) among non-occupational MMs.

The 1997 Helsinki criteria for attribution to occupational exposure would have excluded more than 30% of MMs under study: here occupational exposures ceased on average 26 years before the disease, and therefore clearance and time since last exposure must be taken into account because are relevant determinants of the retained amount of fibres.

Conclusions The risk of MM increases with the amount of retained amphibole, and to a lesser extent, of chrysotile fibres. Because occupational and non-occupation asbestos exposures have been to mixture of fibres, the lungs of MM patients are still loaded with amphibole AF.