These days, some initial studies started to address the health of workers exposed to novel types of manufactured nanomaterials. These studies face three main challenges: exposure assessment, identification of suitable effect markers and size of populations. The relatively small current workforces in individual countries will probably necessitate the pooling of cohorts internationally. However, at the moment, the necessary conditions for such a pooling are not in place: namely agreements on design, exposure and effect characterisation are not in place. To bridge this gap and to provide a coherent approach in view of future epidemiological research, we recently proposed a roadmap [1] to reach global consensus on need a well defined, globally harmonised framework for the careful choice of materials, exposure characterisation, identification of study populations, definition of health endpoints, evaluation of appropriateness of study designs, data collection and analysis, and interpretation of the results. The proposed strategy should ensure that the costs of action are not disproportionate to the potential benefits, and importantly, that the approach is pragmatic and practical. Moreover, we should aim to go beyond the collection of health complaints, illness statistics or even counts of deaths: the manifestation of such clear endpoints would indicate a failure of preventive measures. Instead, we should agree on a minimum set of biomarkers and metrics of early effects for acute and chronic diseases while evaluating how concepts of systems biology, gene activation and epigenetics can inform such studies on outcomes and related biomarkers of potential interest.

187 MONITORING AND MODELLING OF EXPOSURE TO MANUFACTURED NANO OBJECTS, AGGLOMERATES & AGGREGATES (NOAA) FOR EPIDEMIOLOGIC STUDIES

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Introduction A major challenge for setting up human field studies is the identification of sufficiently large number of workers with exposure to NOAAs. Pooling of data is necessary but requires harmonisation of methods. A multi-metric exposure approach is proposed, which may be better correlated to health effects, however, an appropriate exposure estimate has not been developed yet. Currently, workers' activities/tasks related to NOAA are time wise highly variable resulting in considerable within-worker, between-day variances. No validated models exist to predict exposure to NOAA, however, the concepts of such a source-receptor model have been presented, and for specific activities (i.e. powder handling or spraying) more detailed models are being developed. Meanwhile larger datasets on (mostly task-based) occupational (estimates of) exposure to NOAA are available, e.g. the NANOSH study, or will be built. Database structures are actively developed, e.g. the PEROSH -NECID database, and harmonised workplace exposure studies generating data will populate the NECID database in near future.
Methods and Results The challenges for exposure assessment for epidemiologic studies can be addressed by developing task-based exposure matrices profiles covering scenario's across the product chain of NOAA. Building blocks for such task-based exposure matrices will be existing models and those that are under development, e.g. Stoffenmanager nano, NanoSafer, further analysis of existing datasets to demonstrate task-specific exposures and tailored task-based measurements. Combined with worker specific information on type of NOAA, and frequency, duration etc. of activities/tasks per job title, estimates for exposure can be derived. In addition, co-exposures from process or combustion derived ultrafine particles will be taken into account. A multi-pathway approach is used, however, the focus will be on the inhalation route. Currently, the feasibility of such an approach is explored in a pilot study, which is supported by an extensive measurement campaign in the facility.

188 FROM THE VERY SMALL TO THE VERY LARGE: CHALLENGES IN CONDUCTING EPIDEMIOLOGIC STUDIES OF US WORKERS EXPOSED TO CARBON NANOTUBES

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Objectives Carbon nanotubes (CNT) and carbon nanofibers (CNF) are among the first nanomaterials to reach commercial use in the US and are also showing evidence of serious health effects at occupationally relevant levels in toxicology studies. The objective of our work was to design an epidemiologic study of early possible health effects among US workers exposed to CNT and CNF, taking into account small workforce sizes, a global manufacturing and distribution system, uncertainty about which exposure metrics may best correlate with health effects, and short available latency.
Methods Initial exposure characterisation was conducted at 15 US manufacturers and users of CNT and CNF to determine the most specific and useful exposure metrics. Possible markers of early pulmonary, cardiovascular, and malignant health effects were identified from animal toxicology studies and epidemiologic research among populations exposed to ambient ultrafine particles. Power analyses were conducted to determine appropriate sample sizes.
Results A cross-sectional exposure assessment and epidemiology study was designed; it will include 100 workers from at least 10 US facilities making or using CNT or CNF. This study, now in progress, evaluates elemental mass and electron microscopy-based exposure metrics for each worker, along with early health outcomes including spirometry measures, blood pressure, and approximately 40 biomarkers of inflammation, oxidative stress, pulmonary fibrosis, cardiovascular disease, and cancer. The study will account for ambient ultrafine exposure using a combination of background sampling and non-specific direct-reading instruments that operate in the nanoscale range.
Conclusions Cross-sectional epidemiologic designs for nanomaterial exposures are feasible, but small workforce sizes and generally short latency limit power; cohort studies for outcomes such as malignant and nonmalignant respiratory and other disease may require international pooling. Researchers should collaborate to identify the most suitable exposure metrics and early health outcomes.

189 MEDICAL SURVEILLANCE AND EPIDEMIOLOGIC STUDIES OF ENGINEERED NANOMATERIALS (ENM) WORKERS IN FRANCE

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