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In the present study, a reporter gene assay was used to investigate the activities of 11 PBDEs and six OH-PBDEs with different degrees of bromination on zebrafish RAR. All tested OH-PBDEs induced RAR transcriptional activity; however, of the 11 PBDEs examined, only BDE28 and BDE154 affected the RAR transcriptional activity. Homology modelling and molecular docking were employed to simulate the interactions of PBDEs/OH-PBDEs with zebrafish RARs and to identify binding affinities to analyse the specialisation of the interaction between RARs and PBDEs/OH-PBDEs. The results showed that although these compounds could bind with RARs, the effects of PBDEs/OH-PBDEs on RAR transcriptional activity did not depend on their RAR-binding abilities. The authors concluded that the present study is the first attempt to demonstrate that OH-PBDEs could induce RAR transcriptional activity by binding directly with RAR; these effects are possibly related to the structure of the compounds, especially their hydroxylation and bromination. Most of the PBDEs could not directly interact with the RAR.

Authors: Zhao J, Zhu X, Xu T, Yin D.

This study evaluated the overt toxicity, uptake, and neurobehavioral effects of tris (1,3-dichloro-2-propyl) phosphate (TDCPP), tris (2-chloroethyl) phosphate (TCEP), tris (1-chloro-2-propyl) phosphate (TCP), and tris (2,3-dibromopropyl) phosphate (TDBPP) in early life stage zebrafish.
were exposed to 1 µM of each organophosphate (OP) flame retardant and collected on 1 and 5 dpf to monitor accumulation. Larval swimming activity was measured in 6 dpf larvae to evaluate neurobehavioral effects of exposures below the acute toxicity threshold. TDBPP elicited the greatest toxicity at >1 µM. TDCPP and chlorpyrifos were overtly toxic at concentrations ≥10 µM, TCEP, and TCPP were not overtly toxic at the doses tested. Tissue concentrations increased with increasing hydrophobicity of the parent chemical after 24 h exposures. TDCPP and TDBPP and their respective metabolites were detected in embryos on 5 dpf. For all chemicals tested, developmental exposures that were not overtly toxic significantly altered larval swimming activity. The authors concluded that these data indicate that OPFRs adversely affect development of early life stage zebrafish.

Authors: Dishaw LV, Hunter DL, Padnos B, Padilla S, Stapleton HM.


Noninvasive analysis of metabolic changes following nutrient input into diverse fish species, as investigated by metabolic and microbial profiling approaches

2014-11-18

An NMR-based metabolomic approach in aquatic ecosystems is valuable for studying the environmental effects of pharmaceuticals and other chemicals on fish. This technique has also contributed to new information in numerous research areas, such as basic physiology and development, disease, and water pollution. In the present study, the authors evaluated the microbial diversity in various fish species collected from Japan’s coastal waters using next-generation sequencing, followed by evaluation of the effects of feed type on co-metabolic modulations in fish-microbial symbiotic ecosystems in laboratory-scale experiments. Intestinal bacteria of fish in their natural environment were characterised (using 16S rRNA genes) for trophic level using pyrosequencing and noninvasive sampling procedures developed to study the metabolism of intestinal symbiotic ecosystems in fish reared in their environment. Metabolites in faeces were compared, and intestinal contents and feed were annotated based on HSQC and TOCSY using SpinAssign and network analysis. Faeces were characterised by species and varied greatly depending on the feeding types. In addition, faeces samples demonstrated a response to changes in
As a pilot approach to describe adverse human health effects from alternative decentralised community water systems compared to conventional centralised services (business-as-usual [BAU]), selected chemical and microbial hazards were assessed using disability adjusted life years (DALYs) as the common metric. The alternatives included: (1) composting toilets with septic system, (2) urine-diverting toilets with septic system, (3) low flush toilets with blackwater pressure sewer and on-site greywater collection and treatment for nonpotable reuse, and (4) alternative 3 with on-site rainwater treatment and use. Various pathogens (viral, bacterial, and protozoan) and chemicals (disinfection byproducts [DBPs]) were used as reference hazards. The exposure pathways for BAU included accidental ingestion of contaminated recreational water, ingestion of cross-connected sewage to drinking water, and shower exposures to DBPs. The alternative systems included ingestion of treated greywater from garden irrigation, toilet flushing, and crop consumption; and ingestion of treated rainwater while showering. The pathways with the highest health impact included the ingestion of cross-connected drinking water and ingestion of recreational water contaminated by septic seepage. These were also among the most uncertain when characterising input parameters, particularly the scale of the cross-connection event, and the removal of pathogens during groundwater transport of septic seepage. A comparison of the health burdens indicated potential health benefits by switching from BAU to decentralized water and wastewater systems.

Authors: Schoen ME, Xue X, Hawkins TR, Ashbolt NJ.

High throughput sample processing and automated scoring
2014-11-18

The comet assay is a sensitive and versatile method for assessing DNA damage in cells. In the traditional version of the assay, there are many manual steps involved and few samples can be treated in one experiment. High throughput (HT) modifications have been developed during recent years, and they are reviewed and discussed in the present study. These modifications include accelerated scoring of comets; other important elements that have been studied and adapted to HT are cultivation and manipulation of cells or tissues before and after exposure, and freezing of treated samples until comet analysis and scoring. HT methods save time and money but they are useful also for other reasons: large-scale experiments may be performed which are otherwise not practicable (e.g., analysis of many organs from exposed animals, and human biomonitoring studies), and automation gives more uniform sample treatment and less dependence on operator performance. The HT modifications now available vary largely in their versatility, capacity, complexity, and costs. The authors concluded that the bottleneck for further increase of throughput appears to be the scoring.


The effects of environmental toxins on allergic inflammation
2014-11-18

The prevalence of asthma and allergic disease has increased worldwide over the last few decades. Many common environmental factors are associated with this increase. Several theories have been proposed to account for this trend, especially those concerning the impact of environmental toxicants. The development of the immune system, particularly in the prenatal period, has far-reaching consequences for health during early childhood, and throughout adult life. One underlying mechanism for the increased levels of allergic responses, secondary to exposure, appears to be an imbalance in the T-helper function caused
Reference standards are especially valuable when performing a series of experiments over a long period—for example, analysing samples of white blood cells from a large human biomonitoring trial—to check that the assay is performing consistently, and to identify anomalous results necessitating a repeat experiment.

Authors: Yang SN, Hsieh CC, Kuo HF, Lee MS, Huang MY, Kuo CH, Hung CH.


Controlling variation in the comet assay

Variability of the comet assay is a serious issue, whether it occurs from experiment to experiment in the same laboratory, or between different laboratories analysing identical samples. Do we have to live with high variability, just because the comet assay is a biological assay rather than analytical chemistry? Numerous attempts have been made to limit variability by standardising the assay protocol, and the critical steps in the assay have been identified; agarose concentration, duration of alkaline incubation, and electrophoresis conditions (time, temperature, and voltage gradient) are particularly important. Even when these are controlled, variation seems to be inevitable. It is helpful to include in experiments reference standards, i.e., cells with a known amount of specific damage to the DNA. They can be aliquots frozen from a single large batch of cells, either untreated (negative controls) or treated with, for example, H2O2 or X-rays to induce strand breaks (positive control for the basic assay), or photosensitiser plus light to oxidise guanine (positive control for Fpg- or OGG1-sensitive sites). Reference standards are especially valuable when performing a series of experiments over a long period—for example, analysing samples of white blood cells from a

by exposure to the toxicants. Exposure to environmental endocrine-disrupting chemicals can result in dramatic changes in cytokine production, the activity of the immune system, the overall Th1 and Th2 balance, and in mediators of type 1 hypersensitivity mediators, such as IgE. Passive exposure to tobacco smoke is a common risk factor for wheezing and asthma in children. People living in urban areas and close to roads with a high volume of traffic, and high levels of diesel exhaust fumes, have the highest exposure to environmental compounds, and these people are strongly linked with type 1 hypersensitivity disorders and enhanced Th2 responses. These findings are consistent with epidemiological research that has consistently detected increased incidences of allergies and asthma in people living in these locations. During recent decades more than 100,000 new chemicals have been used in common consumer products and are released into the everyday environment. Therefore, in this review, the authors discuss the environmental effects on allergies of indoor and outside exposure.

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This review describes the various types of endogenous human developmental milestones such as birth, puberty, and menopause, as well as the diverse exogenous environmental factors that influence human health, in a chronological epigenetic context.

Authors: Collins AR, El Yamani N, Lorenzo Y, Shaposhnikov S, Brunborg G, Azqueta A.


Epigenetics across the human lifespan

2014-11-18

Epigenetics has the potential to explain various biological phenomena that have heretofore defied complete explication. The authors describe the entire course of human life from periconception to death and chronologically note all of the potential internal time points and external factors that influence the human epigenome. Ultimately, the environment presents these various factors to the individual that influence the epigenome, and the unique epigenetic and genetic profile of each individual also modulates the specific response to these factors. During the course of human life, we are exposed to an environment that abounds with a potent and dynamic milieu capable of triggering chemical changes that activate or silence genes. There is constant interaction between the external and internal environments that is required for normal development and health maintenance as well as for influencing disease load and resistance. For example, exposure to pharmaceutical and toxic chemicals, diet, stress, exercise, and other environmental factors are capable of eliciting positive or negative epigenetic modifications with lasting effects on development, metabolism and health. These can impact the body so profoundly as to permanently alter the epigenetic profile of an individual. The authors also present a comprehensive new hypothesis of how these diverse environmental factors cause both direct and indirect epigenetic changes and how this knowledge can ultimately be used to improve personalised medicine.

Authors: Kanherkar RR, Bhatia-Dey N, Csoka AB.


large human biomonitoring trial-to check that the assay is performing consistently, and to identify anomalous results necessitating a repeat experiment. The reference values of tail intensity can also be used to iron out small variations occurring from day to day. In the present study, the authors present examples of the use of reference standards in human trials, both within one laboratory and between different laboratories, and describe procedures that can be used to control variation.

Authors: Collins AR, El Yamani N, Lorenzo Y, Shaposhnikov S, Brunborg G, Azqueta A.

Genotoxic effects of two-generational selenium deficiency in mouse somatic and testicular cells

2014-11-18

Many studies have investigated genotoxic effects of high Se diets but very few have addressed the genotoxicity of Se deprivation and its consequences in germ cells and none in somatic cells. To address these data gaps, C57BL/6 male mice were subjected to Se deprivation starting in the parental generation, i.e. before conception. Mice were given a diet of either low (0.01mg Se/kg diet) or normal (0.23mg Se/kg diet) Se content. Ogg1-deficient (Ogg1 (-/-) ) mice were used as a sensitive model towards oxidative stress due to their reduced capacity to repair oxidised purines. Ogg1 (-/-) mice also mimic the repair characteristics of human post-meiotic male germ cells, which have a reduced ability to repair such lesions. The genotoxicity of Se deficiency was addressed by measuring DNA lesions with the alkaline single cell gel electrophoresis (+ Fpg to detect oxidised DNA lesions) in somatic cells (nucleated blood cells and lung cells) and male germ cells (testicular cells). Total Se concentration in liver and GPx activity in plasma and testicular cells were measured. Gene mutation was evaluated by an erythrocyte-based Pig-a assay. The authors discovered that Se deprivation of F1 from their conception and until early adulthood led to the induction of DNA lesions in testicular and lung cells expressed as significantly increased levels of DNA lesions, irrespective of the mouse genotype. In blood cells, Se levels did not appear to affect DNA lesions or mutant cell frequencies. The authors concluded that the results suggest that the testis was the most sensitive tissue. Thus, genotoxicity induced by the low Se diet in the spermatozoal genome has potential implications for the offspring.

Authors: Graupner A, Instanes C, Andersen JM, Brandt-Kjelsen A, Dertinger SD, Salbu B, Brunborg G, Olsen AK.


Improving the risk assessment of lipophilic persistent environmental chemicals in breast milk

2014-11-18

Lipophilic persistent environmental chemicals (LPECs) have the potential to accumulate within a woman's body lipids over the course of many years prior to pregnancy, to partition into human milk, and to transfer to infants upon breastfeeding. As a result of this accumulation and partitioning, a breastfeeding infant’s intake of these LPECs may be much greater than...
his/her mother’s average daily exposure. Because the developmental period sets the stage for lifelong health, it is important to be able to accurately assess chemical exposures in early life. In many cases, current human health risk assessment methods do not account for differences between maternal and infant exposures to LPeCs or for lifestage-specific effects of exposure to these chemicals. Because of their persistence and accumulation in body lipids and partitioning into breast milk, LPeCs present unique challenges for each component of the human health risk assessment process, including hazard identification, dose-response assessment, and exposure assessment. Specific biological modelling approaches are available to support both dose-response and exposure assessment for lactational exposures to LPeCs. Yet, lack of data limits the application of these approaches. The goal of this review is to outline the available approaches and to identify key issues that, if addressed, could improve efforts to apply these approaches to risk assessment of lactational exposure to these chemicals.


OCCUPATIONAL RESEARCH

Measuring Allostatic Load in the Workforce-A Systematic Review

2014-11-18

The Allostatic Load Index (ALI) has been used to establish associations between stress and health-related outcomes. This review summarises the measurement and methodological challenges of allostatic load in occupational settings. Databases of Medline, PubPsych, and Cochrane were searched to systematically explore studies measuring ALI in working adults following the PRISMA statement. Study characteristics, biomarkers and methods were tabulated. Methodological quality was evaluated using a standardised checklist. Sixteen articles (2003-2013) met the inclusion criteria, with a total of 39 (range 6-17) different variables used to calculate ALI. Substantial heterogeneity was observed in the number
and type of biomarkers used, the analytic techniques applied and study quality. Particularly, primary mediators were not regularly included in ALI calculation. Consensus on methods to measure ALI in working populations is limited. Research should include longitudinal studies using multi-systemic variables to measure employees at risk for biological wear and tear.

Authors: Mauss D, Li J, Schmidt B, Angerer P, Jarczok MN.

Full Source: Industrial Health. 2014 Sep 13. [Epub ahead of print]

**Occupational Exposure to N,N-Dimethylformamide in the Summer and Winter**

*2014-11-18*

In the present study, the authors evaluated total body burden of N,N-dimethylformamide (DMF) taken through the lung and skin by personal exposure of workers to DMF and urinalysis of N-methylformamide (NMF) and N-acetyl-S-(N-methylcarbamoyl)-cysteine (AMCC). A total of 270 workers were engaged in four different jobs in a workplace distant from main production lines emanating high levels of DMF. They were not required to wear any personal protective equipment including respirators or gloves. The authors discovered that log-transformed urinary levels of NMF and AMCC increased with an increase in log-transformed concentrations of exposure to DMF. Urinary levels of NMF and AMCC were significantly higher in the summer than the winter, although there was no significant seasonal difference in the concentrations of exposure to DMF. The authors concluded that based on their findings that the increased urinary levels of NMF and AMCC in the summer resulted in increased skin absorption of DMF due to an increased amount of DMF absorbed by the moisturised skin under humid and hot conditions. Seasonal changes in the relative internal exposure index confirmed the present finding of enhanced summertime skin absorption of DMF. AMCC is thought to be a useful biomarker for assessments of cumulative exposure to DMF over a workweek and for evaluations of workers’ health effects.

Authors: Miyauchi H, Tsuda Y, Minozoe A, Tanaka S, Arito H, Tsukahara T, Nomiyama T.

Full Source: Industrial Health. 2014 Sep 13. [Epub ahead of print]
Technical

Prevalence of Subjective Symptoms among Hospital Pharmacists and Association with Drug Compounding Practices

2014-11-18

In Japan, the principal role of hospital pharmacists has changed from that of dispensing medicines for outpatients to provision of clinical pharmacy services for inpatients. A self-administered questionnaire about subjective symptoms, working patterns, work environments and job satisfaction was administered to 495 hospital pharmacists and 84 prefectural office-based pharmacists (control group). The response rates were 63.4% and 90.5%, respectively. Hospital pharmacists showed a higher prevalence of nasal symptoms than that shown by the control office-based pharmacist group. The prevalence rate of nasal symptoms was lower only in male pharmacists who worked in a dispensary equipped with dust collector. The prevalence of symptoms noticed by hospital pharmacists and community pharmacists after starting drug compounding practices was also compared. The prevalence of subjective symptoms that pharmacists noticed after starting drug compounding was lower in hospital pharmacists than in community pharmacists. Job satisfaction was lower in hospital pharmacists than in office-based pharmacists; however, there was no clear association between the subjective symptoms reported and job satisfaction. The authors concluded that further studies on removal effect of drug dust in a dispensary and symptoms in individual pharmacy facilities are needed.

Authors: Inaba R, Hioki A, Kondo Y, Nakamura H, Nakamura M.

Full Source: Industrial Health. 2014 Sep 13. [Epub ahead of print]

Comparison of musculoskeletal disorder health claims between construction floor layers and a general working population

2014-11-18

This study compared rates of medical insurance claims for musculoskeletal disorders (MSD) between workers in a construction trade and a general worker population to determine if higher physical exposures in construction lead to higher rates of claims on personal medical insurance. Health insurance claims between 2006 and 2010 from floor layers were frequency matched by age, gender, eligibility time and geographic location to claims from insured workers in general industry obtained
from MarketScan. The authors extracted MSD claims and dates of service from six regions of the body: neck, low back, knee, lower extremity, shoulder and distal arm, and evaluated differences in claim rates. The results showed that fifty-one per cent of floor layers (n=1475) experienced musculoskeletal claims compared with 39% of MarketScan members (p<0.001). Claim rates were higher for floor layers across all body regions with nearly double the rate ratios for the knee and neck regions (RR 2.10 and 2.07). The excess risk was greatest for the neck and low back regions; younger workers had disproportionately higher rates in the knee, neck, low back and distal arm. A larger proportion of floor layers (22%) filed MSD claims in more than one body region compared with general workers (10%; p<0.001). The authors concluded that floor layers have markedly higher rates of MSD claims compared with a general worker population, suggesting a shifting of medical costs for work-related MSD to personal health insurance. The occurrence of disorders in multiple body regions and among the youngest workers highlights the need for improved work methods and tools for construction workers.

Authors: Dale AM, Ryan D, Welch L, Olsen MA, Buchholz B, Evanoff B.


General background and practical implementation of the health management service institution in Korea

2014-11-18

The Korean Occupational Safety and Health Act requires an employer with more than 50 employees to assign a health manager or an occupational physician. However, there are many cases where it is difficult for medium-scale enterprises to perform occupational health practices autonomously because their financial base is weaker than that of large-scale enterprises. The Korean Occupational Safety and Health Act was amended in 1990 so that medium-scale enterprises could entrust a health management service institution with their health management tasks. This system is similar to the outsourcing of medical examinations, occupational physicians, or the measurement of the working environment in Japan, but its legal background and actual activities are Korea-specific, and it has some different points. In particular, the quality control of health management service institutions by legal and administrative regulations, and the multidisciplinary provision of services contribute to the development of occupational health in medium-scale enterprises. This will be a good
Technical

reference for occupational health services in small- and medium-scale enterprises in the future in Japan.

Authors: Okahara S, Lee BW, Ogasawara T, Mori K.


PUBLIC HEALTH RESEARCH

The impact of REACH on classification for human health hazards

2014-11-18

The ReACH Regulation represents a major piece of chemical legislation in the EU and requires manufacturers and importers of chemicals to assess the safety of their substances. The classification of substances for their hazards is one of the crucial elements in this process. This study analysed the effect of ReACH on classification for human health endpoints by comparing information from ReACH registration dossiers with legally binding, harmonised classifications. The analysis included 142 chemicals produced at very high tonnages in the EU, the majority of which have already been assessed in the past. Of 20 substances lacking a harmonised classification, 12 chemicals were classified in ReACH registration dossiers. More importantly, 37 substances with harmonised classifications for human health endpoints had stricter classifications in registration dossiers and 29 of these were classified for at least one additional endpoint not covered by the harmonised classification. Substance-specific analyses suggest that one third of these additional endpoints emerged from experimental studies performed to fulfill information requirements under ReACH, while two thirds resulted from a new assessment of pre-REACH studies. The authors concluded that ReACH leads to an improved hazard characterisation even for substances with a potentially good data basis.

Authors: Oltmanns J, Bunke D, Jenseit W, Heidorn C.


This study analysed the effect of REACH on classification for human health endpoints by comparing information from ReACH registration dossiers with legally binding, harmonised classifications.
Acrylonitrile exposure assessment in the emergency responders of a major train accident in Belgium: A human biomonitoring study

2014-11-18

On 4 May 2013, a train transporting chemicals derailed in Wetteren, Belgium. Several tanks loaded with acrylonitrile (ACN) exploded, resulting in a fire and a leakage of ACN. This study determined the exposure to ACN and assessed the discriminating factors for ACN exposure in the emergency responders involved in the on-site management of the train accident. The study population consisted of 841 emergency responders. Between 21 May and 28 June, they gave blood for the determination of N-2-cyanoethylvaline (CEV) haemoglobin adducts and urine for the measurement of cotinine. They also filled in a short questionnaire. One hundred and sixty-three (26%) non-smokers and 55 (27%) smokers showed CEV concentrations above the reference values of 10 and 200pmol/g globin, respectively. The 95th percentile in the non-smokers was 73pmol/g globin and the maximum was 452pmol/g globin. ACN exposure among the non-smokers was predicted by (1) the distance to the accident, (2) the duration of exposure, and (3) the occupational function. Emergency responders involved in the on-site management of the train accident were clearly exposed to ACN from the accident. However, the extent of exposure remained relatively moderate with CEV concentrations staying within the ranges described in literature as background for a smoking population. Moreover, the exposure was less pronounced in the emergency responders as compared to that in the local population.


Determinants of bisphenol A and phthalate metabolites in urine of Flemish adolescents

2014-11-18

As part of the second Flemish Environment and Health Study (FLEHS II), bisphenol-A (BPA) and different phthalate metabolites were analysed, for the first time, in the urine of 210 adolescents in Flanders, Belgium. All chemicals had a detection frequency above 90%. For all compounds, except the sum of DEHP, highest levels were detected during spring.
Average values for the Flemish adolescents were in agreement with concentrations found in different international studies, all confirming the ubiquity of BPA and phthalate exposure. There was a significant correlation between BPA and the different phthalate metabolites (r between 0.26 and 0.39; p<0.01). Shared sources of exposure to BPA and phthalates, such as food packaging, were suggested to be responsible for this positive correlation. Different determinants of exposure were evaluated in relation to the urinary concentrations of these chemicals. For BPA, a significant association was observed with household income class, smoking and exposure to environmental tobacco smoke. For phthalates, the following significant associations were observed: age (MBzP), educational level of the adolescent (MBzP), equivalent household income (MnBP), use of personal care products (MnBP and MBzP), wall paper in house (MnBP and MBzP) and use of local vegetables (MnBP).


**Perfluorochemicals and Human Semen Quality: The LIFE Study**

2014-11-18

The relation between persistent environmental chemicals and semen quality is evolving, though limited data exist for men recruited from general populations. In this study, the authors assessed the relation between perfluorinated chemicals (PFCs) and semen quality among 501 male partners of couples planning pregnancy. Utilising population-based sampling strategies, the authors recruited 501 couples discontinuing contraception from two U.S. geographic regions from 2005-2009. Baseline interviews and anthropometric assessments were conducted followed by blood collection for the quantification of 7 serum PFCs (perfluorosulfonates, perfluorocarboxylates and perfluorosulfonamides) using tandem mass spectrometry. Men collected a baseline semen sample and another approximately a month later. Semen samples were shipped with freezer packs, and analyses were performed on the day after collection. Linear regression was used to estimate the difference in each semen parameter associated with a one unit increase in the respective chemical.
in the natural log transformed PFC concentration after adjusting for confounders and modelling repeated semen samples. Sensitivity analyses included optimal Box-Cox transformation of semen quality endpoints. Six PFCs (2-N-methyl-perfluorooctane sulfonamide acetate [Me-PFOSA-AcOH], perfluorodecanoate [PFDeA], perfluorononanoate [PFNA], perfluorooctane sulfonamide [PFOSA], perfluorooctane sulfonate [PFOS], and perfluorooctanoate [PFOA]) were associated with 17 semen quality endpoints before Box Cox transformation. PFOSA was associated with smaller sperm head area and perimeter, lower percentage of DNA stainability, and a higher percentage of bicephalic and immature sperm. PFDeA, PFNA, PFOA, and PFOS were associated with a lower percentage of sperm with coiled tails. The authors concluded that select PFCs were associated with certain semen endpoints, with the most significant associations observed for PFOSA though with results in varying directions.

Authors: Buck Louis GM, Chen Z, Schisterman EF, Kim S, Sweeney AM, Sundaram R, Lynch CD, Gore-Langton RE, Barr DB.

Full Source: Environmental Health Perspectives. 2014 Aug 15. [Epub ahead of print]

Exploiting monitoring data in environmental exposure modelling and risk assessment of pharmaceuticals

2014-11-18

In order to establish the environmental impact of an active pharmaceutical ingredient (API), good information on the level of exposure in surface waters is needed. Exposure concentrations are typically estimated using information on the usage of an API as well as removal rates in the patient, the wastewater system and in surface waters. These input data are often highly variable and difficult to obtain, so model estimates often do not agree with measurements made in the field. In this study, the authors present an approach which uses inverse modelling to estimate overall removal rates of pharmaceuticals at the catchment scale using a hydrological model as well as prescription and monitoring data for a few representative sites for a country or region. These overall removal rates are then used to model exposure across the broader landscape. Evaluation of this approach for APIs in surface waters across England and Wales showed good agreement between modelled exposure distributions and available monitoring data. The use of the approach, alongside estimates
of predicted no-effect concentrations for the 12 study compounds, to assess risk of the APIs across the UK landscape, indicated that, for most of the compounds, risks to aquatic life were low. However, ibuprofen was predicted to pose an unacceptable risk in 49.5% of the river reaches studied. For diclofenac, predicted exposure concentrations were also compared to the Environmental Quality Standard previously proposed by the European Commission and 4.5% of river reaches were predicted to exceed this concentration. While the current study focused on pharmaceuticals, the approach could also be valuable in assessing the risks of other ‘down the drain’ chemicals and could help inform our understanding of the important dissipation processes for pharmaceuticals in the pathway from the patient to ecological receptors.

Authors: Boxall AB, Keller VD, Straub JO, Monteiro SC, Fussell R, Williams RJ.