Pharmaceutical Agents in the Water Cycle

The presence of pharmaceutical agents in the water cycle poses an unpredictable and only partly controllable risk for drinking water supply systems. The conditions for the emergence and the dynamics of this *systemic risk* are as yet unidentified. Of particular interest are the roles and perspectives of the different actors: How do they perceive the risk and how does this perception influence the recognition of need for action and the implementation of management strategies? The research project »Management Strategies for Pharmaceuticals in Drinking Water *(start)*« addresses this problem with the aim to integrate different sectoral measures for the reduction of emissions of pharmaceuticals into a systemic management strategy.

Limits to Knowledge

It is difficult to ascertain if a hazard for humans and the environment has to be expected, since the problem is characterised by a high degree of uncertainty and nescience: Long-term effects of a continuous exposure to pharmaceutical agents in sub-therapeutic doses are as unexplored as the impacts of their numerous metabolites. At the same time one can safely assume that problem specific knowledge deficits will basically persist both practically due to the large amount of pharmaceuticals already on the market and fundamentally due to the inherent complexity of the problem.

Environmental Relevance and Drinking Water Exposure

Health protection and environmental protection are societal aims which usually accompany each other. However, the recently boosted discussion on the environmental relevance of pharmaceuticals shows that both aims can become mutually inconsistent. After the intake pharmaceutical agents are excreted partly unchanged with urine and can be emitted into the environment via municipal sewage. Today they are, in fact, detected with significant concentration in many surface waters within Germany and across Europe as well as in ground waters, which are influenced by bank filtration. Even in drinking water individual agents are found at trace levels.

Complex Risk Dynamics

This limited knowledge leads to an unpredictable systemic risk for the safeguarding of the drinking water supply. Actual hazards for human health – e.g. as a consequence of the occurrence of resistant germs due to antibiotics in waters – and fundamental conflicts of interest along the question of an effective supply with pharmaceuticals and the provision of hygienically unobjectionable drinking water combine with the population's subjective perception of hazards to a complex risk dynamic. In a situation where risks as a consequence of limited knowledge are hard to assess the precautionary principle calls for action.

Integrated Strategy Development

start aims to combine three sectoral strategy approaches into one integrated management strategy for pharmaceuticals in drinking water. The research programme consists of several interlinked natural and social sciences work packages:

- Assessment of sectoral strategy approaches
- Socio-empirical surveys for strategy acceptances
- Actor analysis and strategy integration
- Development of implementation scenarios
- Development of risk communication instruments
- Information packages for research and practice

start cooperates with partners from pharmaceutical industry, water management, physicians' and pharmacists' associations, consumer councils, health funds and public authorities.

Management Strategies for Pharmaceuticals in Drinking Water

Technical Approach

In a short- to mid-term perspective conventional procedures for urban waste water treatment and drinking water processing are complemented by innovative or established but rarely applied techniques. Procedures suited to effectively eliminate certain pharmaceutical agents are e.g. membrane filtration, reversed osmosis, ozonation, adsorption on activated carbon as well as prolonged retention periods in treatment plants. Constructional changes in water infrastructure can additionally be used to reduce emissions of agents: anaerobic procedures for semi-centralised sewage treatment coupled with process water cycles and mobile filtration and adsorption units or installation of domestic grey water cycles. This strategy mainly appeals to actors of urban water management and municipalities. As far as semi- or decentralised solutions are considered house owners are likewise addressed.

Conduct Approach

In a mid- to long-term perspective prescription, therapy and consultation practices of physicians and pharmacists as well as the patients' use and disposal patterns of pharmaceuticals change towards a higher environmental sensibility. The relationship between physicians and patients plays a key role within this strategy: Knowledge and information about the environmental relevance of pharmaceuticals raise the problem awareness of physicians in the consultation of patients. In order to facilitate the integration of the problem into physicians' everyday practice, it has to be implemented in the medical education and advanced training by actors of education and health policy. Health funds can foster the demand for ecological alternatives by means of changes in the funding of pharmaceuticals and therapies. This increased demand can support pharmaceutical industry in supplying a sustainable product range (e.g. varieties of packaging sizes and potencies).

Agent Approach

In a long-term perspective innovations in sustainable pharmacy lead to the substitution of problematic pharmaceutical agents by those which are simultaneously optimised for efficacy/efficiency in humans and degradability in the environment. The development of such new pharmaceuticals is based upon analyses of structure-activity-relationships: molecular moieties responsible for a desired property of the drug have to be separated from those which are unfavourable for its degradation in the environment. In this sense degradability becomes an equal property of a drug amongst others – integrated in an optimised functionality. The example of Glufosfamide shows the potential of this approach: the glucosidation of the primary Ifosfamide simultaneously lead to an improved biodegradation and intestinal resorption. For the pharmaceutical industry as the main facilitator of this approach, it has to be shown that investments in »benign by design« have substantial economic benefits. Public funding programmes can be set up to initiate corresponding research.

Strategien zum Umgang mit
start Arzneimittelwirkstoffen
im Trinkwasser

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