NO pills IN WATERS

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Interreg IV B NWE project partnership 2012 - 2015

noPILLS report

Summary – English

Table of content

Preface

This summary is an excerpt of the noPILLS final report, published after the noPILLS final conference May 27th / 28th 2015. It contains the results of 3 years work (134 pages), the conference feedback and impressions.

In this excerpt the introduction and project description (chapter 1) are shown, the summarized project results (chapter 8) and the conference itself (chapter 9). To come up with a relatively short and "consumer friendly" summary the decision was taken to omit acknowledgements, abbreviation list and table of content. We kindly ask readers to go for further information and deeper insight to the project webpage www.no-pills.eu.

The noPILLS partner group and advisory board members 2013

Summary

Pharmaceuticals in the Environment are an increasingly recognised risk to the quality of surface- and ground-water. The noPILLS project contributed towards a better understanding of the complex system of processes and – probably more importantly – actors that influence the presence of pharmaceutical micropollutants in waste water and, ultimately, receiving waters. Clearly, a problem as complex and wide-ranging as that of pharmaceuticals in the aquatic environment cannot be comprehensively explored by a single project. However, noPILLS aimed to provide a unique insight into the problem by first defining the range of factors affecting pharmaceuticals in the environment, together with related points for intervention, and then investigating these interventions in a multi- and inter-disciplinary fashion: in developing the concept of a "medicinal chain" (of processes and actors), noPILLS identified potential "levers for intervention" towards the reduction of pharmaceutical ingress into the aquatic environment.

This report describes a series of case studies of applied investigative nature along the medicinal chain, which explored and evaluated a range of levers for intervention for their underlying efficacy, efficiency, barriers and challenges. In summary, the noPILLS project has shown that:

- Pharmaceutical micropollutants are ubiquitous in the aquatic environment in the project areas, and contribute to environmental effects;
- Regional differences exist in environmental conditions, as can be expected due to macro-geographical influences (landscape, climate etc), but conditions can also vary within regions and in time, with the biggest factors being influx of effluents and dilution in the environment; A risk highlighted by noPILLS is that of antibiotic resistance developing in - or being introduced into - the aquatic environment via the sewerage network;
- People, acting both as consumers/patients and as professionals play an important role in the medicinal chain and need to be involved more in intervention activities;
- Strong regional differences exist in factors that are influenced by human behaviour, attitudes, and awareness; most likely this is primarily a result of regional differences in systems (e.g. health system, funding, waste management);
- There appears to be a relatively high level of underlying willingness to 'do the right thing' both by the general public and professionals, which is largely under-utilized due to lack of information, support or means to change behaviour;
- Technological interventions are effective in reducing some pharmaceutical micropollutants but present their own challenges in terms of monetary and energy costs;
- Training, education and awareness raising, together with good stakeholder management and effective communication, are crucial for the success of all forms of intervention.
- There appears to be no single 'silver bullet' intervention point, and the whole medicinal chain needs to be considered for multi-point, targeted intervention.

INTRODUCTION – Background and project aim

The noPILLS project is a partnership of 6 partners from 5 countries (D, F, LU, NL, UK) dealing with pharmaceutical residues in the environment with the focus on water. It started work in 2012 with EU funding from the Interreg IV B programme and presents its results in 2015.

The noPILLS project was developed taking into account results of the previous PILLS project, which from 2008-2012, dealt with the efficiency of – and requirement for – treatment technologies at pharmaceutical pollution point sources (mainly hospitals).

Four of the six noPILLS partners cooperated in the PILLS (2012) project. They extended the project topic from the 20% of the human medicine residues in waste water originating from hospitals (dealt with in the PILLS project) to include the remaining 80%, which arise within a river catchment area and mainly originate from households but also decentralised care installations, industry and commerce.

Equally important, the PILLS project results indicated that engineering and technical solutions alone would not be sufficient to result in a comprehensive reduction of all potentially toxic pharmaceutical residues, especially not at acceptable financial and energy / CO_2 cost.

From this came the recognition that successful abatement measures will also have to address routes into the environment within the catchment (and not only end-of pipe) and involve society at large in reducing human pharmaceutical input into the environment.

Moreover the EU activities focussing on preserving and improving the aquatic environment in Europe have led to the inclusion of three pharmaceuticals on a watch list in 2013 (Directive 2013/39/EU, 2013). In 2015 three additional macrolide antibiotics were added to the watch list (Commission Implementing decision (EU) 2015/495, 2015). The objective of the implementation of the European watch list is to update the available information on the fate of the listed substances in the aquatic environment and consequently, to support a more detailed environmental risk assessment.

In this context, the noPILLS project aimed to provide further information on the fate of pharmaceutical residues in the aquatic environment, and to provide, via a number of case study approaches throughout the project partnership, practical experience on the identification of potential and actually implemented technical and social intervention points across the medicinal product chain with a focus on consumer behaviour, waste water treatment and multi-stakeholder engagement.

The focus of noPILLS is on pharmaceuticals for human consumption; medicinal products for veterinary use have not been studied in detail, although they might form part of the observed pharmaceutical load in the environment.

The graph shows the whole pharmaceutical product chain. An interactive version of the graph developed within the noPILLS project can be seen under www.rivm.nl/en/Topics/P/Pharmaceuticals_in_the_environment.

From previous experiences of the noPILLS partners, a number of key research questions on pharmaceuticals in the environment were identified and sought to be addressed:

- To what level of detail is the "medicinal product chain" known in terms of stakeholders and actors? Considering the whole product chain (or possibly cycle) of a medicinal substance – from development and production by the industry, authorization, marketing, legislation, physicians' choices and prescribing practices, pharmacies, health insurance, patients choices and expectations, consumption pattern, disposal behaviour etc. – which factors influence the release and fate of pharmaceuticals in the environment and to what extent?
- Can emissions of pharmaceutical residues to the water cycle be reduced by segregation measures at source and subsequent separate disposal or treatment?
- To what extent does wrong disposal and incautious handling of pharmaceuticals contribute to the pharmaceutical load in waters?

- If the assumption is validated that a considerable portion of the load has its origin in consumption and behaviour pattern: is there a realistic chance to reduce the impact significantly by information, education, and training?

- Can advanced treatment steps at municipal wastewater treatment plants – under realistic operating conditions – contribute to the reduction of pharmaceutical substances in the environment?

In order to span the wide range of research questions, the noPILLS partners worked in a multi-disciplinary project team, ranging from social science to engineering, biological sciences and IT, and actively sought exchange and collaboration not only between the various disciplines but also considered question of consumption and disposal behaviour in the light of different cultural and administrative contexts.

In essence, the main aim of the noPILLS partnership was to contribute to the European discussions and decision-making process regarding the increasingly recognised problem of pharmaceuticals in the environment.

According to Directive 2013/39/EU "the Commission shall […until September 2015] develop a strategic approach to pollution of water by pharmaceutical substances. That strategic approach shall, where appropriate, include proposals enabling, to the extent necessary, the environmental impacts of medicines to be taken into account more effectively in the procedure for placing medicinal products on the market. In the framework of that strategic approach, the Commission shall, where appropriate, by 14 September 2017 propose measures to be taken at Union and/or Member State level, as appropriate, to address the possible environmental impacts of pharmaceutical substances […] with a view to reducing discharges, emissions and losses of such substances into the aquatic environment, taking into account public health needs and the cost effectiveness of the measures proposed."

The noPILLS project aimed to contribute to this process with the aforementioned multi-disciplinary and trans-regional approach towards gaining and sharing practical experiences from the actual implementation of potential 'levers for intervention' along the medicinal product chain.

The "ethos" of noPILLS

The noPILLS partners formed a unique mix of organizations and staff from different backgrounds, providing complementary skills and opportunities to support investigative work:

- Emschergenossenschaft (EG) and Lippeverband (LV) are two German water boards that have long-term practical experiences in waste water treatment with nearly 60 treatment facilities ranging from a few thousand and some million people equivalents, in close cooperation with all the municipalities in the catchments with in total 3.6 million citizens.

- The Universite de Limoges (UniLim), associated with SIPIBEL (a site of experimentation and an observatory [www.graie.org/Sipibel/index.html]), and Glasgow Caledonian University (GCU) have scientists that work on highly topical research and provided a team of very different experts, bridging between disciplines of civil engineers, biologists, social scientists, communication experts and others.

- The Luxemburg Institute of Science and Technology (LIST) not only brought engineering expertise but also very close cooperation with many institutions and civil society within the Luxemburg community towards the project capabilities.

- The Dutch National Institute for Public Health and the Environment (RIVM) contributed an 'official' view of public health and environmental protection, and supported the partnership with a holistic meta-level analysis of the medicinal chain and its processes and actors, thus providing overarching strategic input.

Overall, the noPILLS partners were convinced from the outset that there is no simple 'silver bullet' for the problem of pharmaceutical micro-pollutants, and that the problem can only be solved by interdisciplinary, long-term action focussed on establishing positive effects for society as a whole.

The project partners' intention for this report is to share their results and experience and thus contribute to the European discussion and subsequent decision making processes.

The partnership is aware that the noPILLS project did not address all possible pharmaceuticals, processes, stakeholders or actors, but the noPILLS partners feel that their interdisciplinary case studies do address a significantly large and wide-ranging number of potential levers for intervention to provide a real contribution to the problem definition and solution.

The hospital waste water treatment facility of the Emschergenossenschaft at Marienhospital Gelsenkirchen (D)

Urine collection campaign in the Centre Hospitalier Emile Mayrisch (Lu)

River sampling campaigns in Scotland (UK)

Advanced treatment tests of the Université de Limoges at the cooperating SIPIBEL site (F)

Collection campaign in all pharmacies in the town Dülmen (D)

Conclusions and policy pointers

This chapter briefly summarises the activities undertaken in the noPILLS project, conclusions taken from these activities and recommendations for intervention actions ("policy pointers"). In the complete final report the section "Conclusions and policy pointers" contains references to the relevant chapters of the report where noPILLS results and processes have been explained.

"Formulating understanding of actors and processes: identification of levers for intervention", describes the whole medicinal product chain from design of pharmaceuticals through to licencing, prescribing, dispensing, use, disposal, and ingress and fate in the environment. Important processes, actors, levers for intervention, and international and regional differences are described especially for those phases of the medicinal product chain that involve users of pharmaceuticals.

This review, whilst concentrating on the situation in the Netherlands, provides important generic policy pointers for consideration outwith their geographical context, and informed the engagement case studies conducted in the noPILLS project.

The conclusions from this chapter are that in the medicinal product chain many actors are active, all taking decisions from their own specific interest, based on regulations specifically made for the partial process they are involved in. These decisions may be health driven, society driven, economy driven, environment driven, etc..

By placing all the partial processes and the interests of the different actors in one scheme, optimization possibilities for the medicinal product chain become clear, resulting in levers to use to optimize the process for society.

In more detail, purchasing choices by or for a patient are influenced by a chain of actors that are mutually interdependent and influence the processes of medicine use and disposal. First, the pharmaceutical industry and market access regulation authorities affect which medicinal products are available to choose from. Additionally, the distribution channel (OTC or prescription) affects availability and subsequent purchase and disposal of medicines. Next to the health problem that the patients have, physicians are known to make different choices in similar clinical situations. Also the reimbursement policy of the insurer affects which medicinal product is used.

Changes by one or more of these actors, will affect whether the medicine needs to be disposed of. Patients have shown to be willing to conduct more effort to dispose of medicine in an environmental friendly way if they are made aware of the problem, but this analysis also shows that also on the institutional level choices can be made to reduce the influx of potentially harmful compounds in the environment.

"Pharmaceuticals in sewage systems and surface waters – status quo", summarises new findings and insights relating to the occurrence of pharmaceuticals in the environment, as were apparent from various sampling campaigns in rivers, wastewater treatment plants and sewage sludges in the UK, France, Luxembourg and Germany.

The corresponding chapter concludes that:

- Pharmaceuticals are ubiquitously present in the receiving aquatic environment and a clear increase in concentrations was observed after sewage effluent enters rivers. Some pharmaceuticals, including macrolide antibiotics, were present in toxicologically relevant concentrations.

  The available environmental dilution is an important factor in the risk ensuing from effluent concentrations; especially where multiple discharges enter the same surface water the dilution capacity can be less than suggested by flow volumes;

- Pharmaceuticals are partly sorbed to sludge by hydrophobic type interactions, but mainly by electrostatic interactions. Stabilisation processes during sludge treatment could modify these interactions depending on the process. Molecules are then available and can reach water bodies;

- Conventional WWTP are effective in reducing ecotoxicity levels but some toxicity remains;

- Over 20 % of Scottish river samples were acutely toxic to aquatic organisms, indicating high pollution levels. However, it must be noted that it is not certain that the toxicity is due to pharmaceutical content alone;

- Sewers may contain a resistant bacteria load. The relative abundance of resistant bacteria in hospital effluents was higher than in an urban effluents;

- The quantification of integrons and relative abundance could be a method to evaluate an overall resistance before a specific identification with molecular technique.

"Reducing the pharmaceutical load at source: engaging society about pharmaceutical consumption and disposal", describes engagement-research activities, primarily with members of the general public in three case-study countries (France, Germany and Scotland) but also, to a degree with some key stakeholders in two partner countries: Germany and France.

Key themes addressed in each activity are (patterns associated with) consumption of prescribed and over-the-counter (OTC) medicines, disposal, attitudes to stakeholders, attitudes to health, and awareness of (associated) environmental issues. As different methodologies were applied specific to the respective research objectives, results are not directly comparable.

However, the activities generally sought to develop understanding of the societal context of medicine use and to identify 'policy pointers' for potential levers to engender behaviour change or to raise levels of awareness.

The chapter concludes that members of the public, patients and healthcare professionals are generally receptive to the idea of reducing the environmental burden arising from medicinal residues in the environment.

Workshop for pharmacists and physicians in Dülmen

However, it would appear that this underlying 'appetite' for an agenda that seeks to reduce medicinal input is hindered by a lack of information, engagement between patients and healthcare professionals, and consistent messages and processes.

Using a range of methodologies, the three case studies indicate a clear sense that members of the public, in particular have a considered view on the (over)use of medication. There is a consistent message that they would wish to have more information on appropriate use and disposal, but that this needs to be in an accessible form. Equally there is a more general view on the lack of information about appropriate disposal mechanisms, again a common view is held that the existing mechanisms for this are inconsistent and more importantly appear to lack clarity. And yet there is a great desire by members of the public in particular to 'do the right thing'.

„Reducing emissions of pharmaceutical residues to surface waters by implementing measures of source segregation", assesses the feasibility and efficiency of source segregation measures on hospital level especially for specific substances like cytostatics or contrast media that, due to the fact that an important amount of substances is administered to ambulant hospital patients or to patients outside of hospitals, may be released into the environment also outside the confines of the hospital. In this sense, the chapter goes beyond separation of hospital wastewaters and concentrates instead on separation of specifically important pharmaceutical substances on the patient-level. Campaigns using urine collection bags were conducted in two hospitals in Luxembourg and Germany.

Local schools in Dülmen worked on themes around pharmaceutical residues in water and addressed wider public with the topic

The chapter concludes that:

- It is possible to include procedures needed for separate collection of urine in the routine treatment of patients in radiology departments;
- The separate collection and disposal of urine of ambulant patients (Luxembourg) and of all patients (Germany) resulted in a detectable reduction of emissions on hospital and catchment level;

Urine collection with special collection bags that go to incineration

- Key for the efficiency of a separation campaigns is the active involvement of medical staff (for the motivation and engagement of patients). There is also a clear need to inform the medical staff about the environmental effects of pharmaceutical residues in the environment;
- The estimated additional amount of time to implement separate collection on the level of radiology departments is 5 to 10 minutes per patient.

„Occurrence and removal of pharmaceuticals by advanced treatment of hospital wastewater", describes occurrence of pharmaceuticals in hospital wastewaters and evaluation of selected hospital wastewater treatment options.

Full-scale evaluation of techniques included membrane bioreactor (MBR), powdered activated carbon (PAC) and ozonation; pilot-scale techniques included advanced oxidation with ferrate, MBR, and ozonation; and small scale techniques concentrated on biological activated carbon (BAC).

These complementary approaches involved long-term monitoring of hospital wastewater and operation of the various wastewater treatment technologies at full-scale hospital WWTP (HWWTP), and short term application of the novel technological approaches at pilot- and small-scale.

The chapter concludes that:

- Iodinated X-ray contrast media (ICM) represent the highest load of micropollutants in hospital effluents (by an order of magnitude). The main load of ICM in hospitals is caused by a few hospital departments (radiology, cardiology);
- Experiences from municipal wastewater treatment can be transferred to hospital wastewater treatment, and adherence to established design criteria for municipal wastewater treatment prevents the inhibition of biochemical wastewater treatment processes by hospital effluents;
- MBR technology improves treatment efficiency regarding micropollutants in comparison to centralised municipal wastewater treatment, and the majority of micropollutant load can be removed;
- Energy demand for decentralised hospital wastewater treatment is higher than for centralised wastewater treatment, but operational efforts (staff, resources) are comparable to centralised WWTPs;
- Source separation of different wastewater streams like rain water, domestic wastewater and effluents of specific hospital departments supports the design and operation of decentralised treatment of hospital effluents. Depending on the boundary conditions, decentralised treatment in combination with source separation measures can be economically viable;

Advanced treatment technology in Gelsenkirchen (D)

- Proper waste management at the hospital is a prerequisite for reliable operation of decentralised HWWTP;
- The innovative and sustainable approach of decentralised wastewater management at the case study hospital resulted in positive public perception for the hospital and the operator of the decentralised HWWTP;
- Novel advanced treatment approaches have the potential to increase energy and resource efficiency of tertiary treatment in decentralised and centralised waste water treatment.

„Tools for targeted communication campaigns", takes cognisance of the fact that dissemination and sharing of complex specialist information in a simplified and informative manner can affect people's attitudes and behaviours towards medicine consumption and disposal.

This Chapter describes activities and tools that were developed and tried in Germany and Scotland, which were targeted at whole-community level (the town of Dülmen) and a specific segment of society: (younger) people engaged in modern media (computer gaming and online information gathering).

The chapter concludes, respectively, that:

- Conventional communication media, such as local newspaper, radio and TV are effective for community-wide communication of awareness activities;
- Posters in doctors' practices and pharmacies are important tools for communication with patients and consumers;
- Doctors and pharmacists should be addressed directly and should be involved in targeted awareness campaigns for patients and consumers.
- Modern media products such as 3D visualization and computer games are potential tools to increase awareness of environmental pollution;
- Initial observations obtained from programmers and user feedback was positive but requires further research and detailed monitoring of user feedback.

Policy pointers:

The noPILLS project partners' intention for this report, as mentioned in Chapter 1, is to share their results and experience and thus contribute to the European discussion and subsequent decision making processes.

The partners feel that their approach of interdisciplinary evaluation of transnational case studies provides a unique insight into practical aspects of intervention measures.

In order to integrate into the ongoing discussion in Europe, which are largely following the structure of the BioIS (2013) study on the environmental risks of medicinal products, we present our recommendations for intervention implementation cross-referenced against seven of the nine non-legislative "factors of influence and possible solutions" **BioIS themes,** keeping in mind that some results could span two or more of these themes:

BioIS-Theme 2: Developing and harmonising the implementation of collection schemes for unused medicinal products (noPILLS report Chapter 3)

Further research and development is recommended to optimise and harmonise the practical operation of pharmaceutical take-back schemes.

As returning medicines to the pharmacy may increase the time medicines are stored at home, suggestions for safe storage of waste medicines may help to address any concerns the public may have.

The BioIS report, elaborated to support the decisions on strategy of the EU Commission

There is existing goodwill around the safe and secure storage of medicines, which can be built upon: People are familiar with the concept of correct and incorrect disposal (e.g. through experience with recycling collections) and are in general prepared to separate their waste and dispose of it correctly, particularly so when considering safety (for people) is an issue. This might be further encouraged.

Clear, consistent information on the practice and rationale of disposal facilities may encourage optimised disposal behaviour. As disposal via toilet or sink still accounts for a large amount of pharmaceuticals, a worthwhile reduction could still be achieved by addressing this behaviour.

Access to repeat prescriptions may lead to stocking up on medicines and harmonised return mechanisms ("medicines amnesty") may lead to increased uptake (by patients and relatives).

How to implement collection systems?

BioIS-Theme 3: Developing source separation measures (noPILLS report Chapter 4) and wastewater treatments (noPILLS report Chapter 5)

- Separate collection and disposal of urine of hospital radiology patients can significantly reduce substance flows of Iodinated X-ray contrast media (ICM) to surface waters;
- Separation at source taking the example of urine separation of ICM on hospital level can even work efficiently under difficult boundary conditions (e.g. patients with different native languages and cultural background);
- Results can be transferred to other substances administered in high amounts in hospitals and having similar properties as ICM (excretion path, persistence etc.);
- Measures of segregation like separate collection of urine might also offer possibilities to recover other specific substances.
- Hospitals are a large source of contrast agents: separate collection (capture) of specific wastewater streams at hospitals is possible and economically feasible;
- Hospital wastewater can be collected prior to dilution in the sewer system;
- Design criteria from municipal wastewater treatment can be transferred to hospital waste water treatment;
- Decentralised treatment of hospital effluents on-site can be reliable;
- MBR treatment efficiency at hospitals can be comparable to the efficiency of advanced tertiary treatment at municipal WWTPs;
- Sanitised effluent can be obtained by ultrafiltration in MBR treatment.

BioIS-Theme 4: Actively involving public society and professionals through information and education (noPILLS report Chapter 3 and Chapter 6)

Medicine use

- There would appear to be an appetite, by members of the general public, as potential patients, for an agenda that seeks to reduce medicinal input – policy might address this be encouraging alternative forms of appropriate therapy;
- People's "over the counter" (OTC) purchasing decisions are influenced by a complex set of factors. This 'diffuse information' source does not offer a single straightforward point of intervention for the reduction of OTC consumption but rather suggests a multi-pronged approach;
- Positive lifestyle choices such as diet and exercise should continue to be promoted both as preventative and as curative health interventions, whilst barriers to implementing these might be explored and addressed;
- Appropriate pack sizes may reduce medicine wastage. Issue of repeat prescriptions, change of therapy and condition of patient (with due consideration!) may also be appropriate moments to reinforce a correct disposal message or offer a collection service.

Potential roles for Stakeholders

- People feel a range of stakeholders could contribute to the reduction of pharmaceutical consumption and are also prepared to accept that they themselves have a role to play;

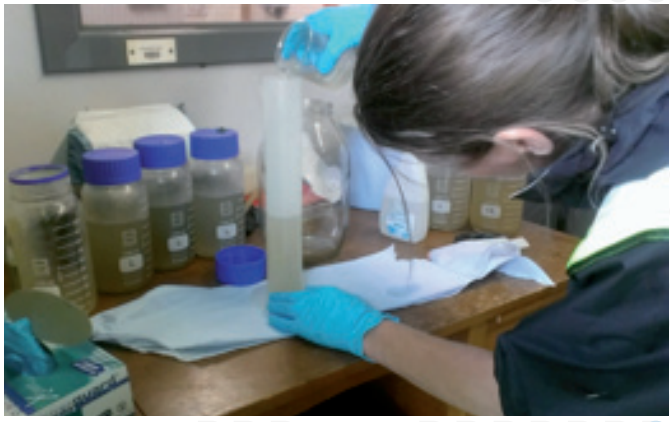
- There are also clear indications that over the longer term substantial engagement with a range of stakeholder groups may generate new approaches to prescribing and acquisition of medicines;
- Pharmacists are seen as key group to inform consumers on environmental consequences and proper way of disposal.

Environmental awareness issues

- Information, education and publicity would be welcomed by members of the public, both on disposal advice and on the wider issue of pharmaceuticals in the environment;
- Simple but professionally designed posters in pharmacies and doctors' surgeries can be very effective for awareness raising of patients and consumers on the issue. The same applies to flyer and leaflets with appropriate information on the issue as supplement to public brochures or corresponding reports in local newspapers, local radios and regional TV.
- Local outreach and wider awareness raising campaigns on thematically complex topics such as pharmaceutical residues in water may benefit from the use of modern communication tools such as 3D visualization and computer games. Further work is needed to verify and quantify the efficacy of these tools.

Theme 5: Prioritising and monitoring molecules and / or environmental compartments of concern (noPILLS report Chapter 3, as well as the whole previous PILLS report)

- Monitoring of raw sewage discharges, especially those from combined sewer overflow in wet weather situations, is recommended. Similarly, non-WWTP sources may contribute significantly to pharmaceutical loads in the aquatic environment. Further research is needed to verify this and to determine the relevance of other sources, as actions to upgrade WWTP may not be sufficient to protect the environment;
- Current levels of several pharmaceuticals, including macrolide antibiotics, in WWTP effluents may pose toxic situations in surface waters unless significant environmental dilution is available. Some of the macrolide antibiotics on the 'Watch list' may be present in sufficient quantities to pose an actual environmental risk. More extensive monitoring of these compounds is recommended;
- Risk assessments should where possible consider realistic available dilution and take account of multiple inputs as cumulative loads;
- Potential contamination of sludge during biological treatment, and stability of sorption, has to be considered in the overall balance of removal and in decision making on the use of sludge in land application;
- Research into the pharmaceutical contribution to toxic effects in surface waters is recommended;
- Research on ecotoxicological tests has to be improved to define the most relevant environmental impact(s) for monitoring;
- It is recommended that ecotoxicity of whole effluent should be considered as a discharge parameter in licensing, in order to account for full complexity of the mixture of whole effluent and surface water bodies;
- The fight against antibiotic resistance requires a range of approaches, which could include:
  - standardization of quantification methods,
  - definition of indicators to monitor ARB – such as integrons used in this study,
  - definition of a methodology for risk assessment,
  - evaluation of gene transfers in anthropic systems;
- Control of resistant bacteria at source could play a role in maintaining effectiveness of antibiotic treatments;
- Fundamental research on resistant bacteria and gene transfer in sewage effluents is recommended.



Lab analysis at Glasgow Caledonian University (UK)

BioIS-Theme 6: Consolidating existing knowledge, ensuring transparency and facilitating access to information (noPILLS project overall as a knowledge exchange activity)

- The indication is that individuals would appreciate more (easily accessible) information about alternatives but also more widely about appropriate related behaviours for example disposal;
- Simple but professionally designed posters in pharmacies and doctors' surgeries can be very effective for awareness raising of patients and consumers on the issue. The same applies to flyer and leaflets with appropriate information on the issue as supplement to public brochures or corresponding reports in local newspapers, local radios and regional TV;
- Local outreach and wider awareness raising campaigns on thematically complex topics such as pharmaceutical residues in water may benefit from the use of modern communication tools such as 3D visualization and computer games. Further work is needed to verify and quantify the efficacy of these tools;
- Prescribing and self-medication is influenced by many factors other than therapeutic need. Marketing, continuing education and professional literature may be useful media to influence behaviour to drive optimal therapeutic and environmental outcomes;
- Including environmental information and appropriate disposal practices in information exchange during prescribing / delivering and on the Patient Information Leaflet (PIL) is recommended, as disposal information in the PIL alone may not be read and alternative information sources may need to be provided;
- There are many misconceptions about what constitutes 'safe' disposal of medicine (for people vs for the environment) and sustained information dissemination is needed to address this. The 'waste disposal' message on pharmaceuticals may be usefully included in local authority recycling information;
- Peer education may be an effective way to encourage behaviour change around disposal.


DSADS

Den Spurenstoffen auf der Spur in Dülmen
Alles klar. Damit unser Wasser ohne Nebenwirkungen bleibt

SIE SIND GEFRAGT

Arzneimittel retten Leben und verbessern die Lebensqualität von kranken Menschen. Sie hinterlassen aber auch Spuren im Wasserkreislauf. So gelangen Wirkstoffe durch falsche Entsorgung, beim Duschen oder dem Gang zur Toilette direkt ins Abwasser und damit auch in unsere Flüsse und Seen. Noch sind die Konzentrationen unbedenklich. Damit das auch in Zukunft so bleibt, ist jeder von uns gefordert. Helfen Sie mit, die gute Wasserqualität in Dülmen zu erhalten. **Damit unser Wasser ohne Nebenwirkungen bleibt.**

DAS KÖNNEN SIE TUN

1. Entsorgen Sie Medikamentenreste nie im Waschbecken oder in der Toilette, sondern über den Hausmüll. So gelangen die Wirkstoffe nicht ins Abwasser.

2. Reduzieren Sie Medikamentenabfälle durch einen klugen Einkauf. Wählen Sie die kleinste Packungsgröße, die für eine erfolgreiche Therapie ausreicht.

3. Sprechen Sie Ihren Arzt darauf an, wenn Sie noch verwendbare Restbestände haben, die für eine anstehende Behandlung ausreichen.

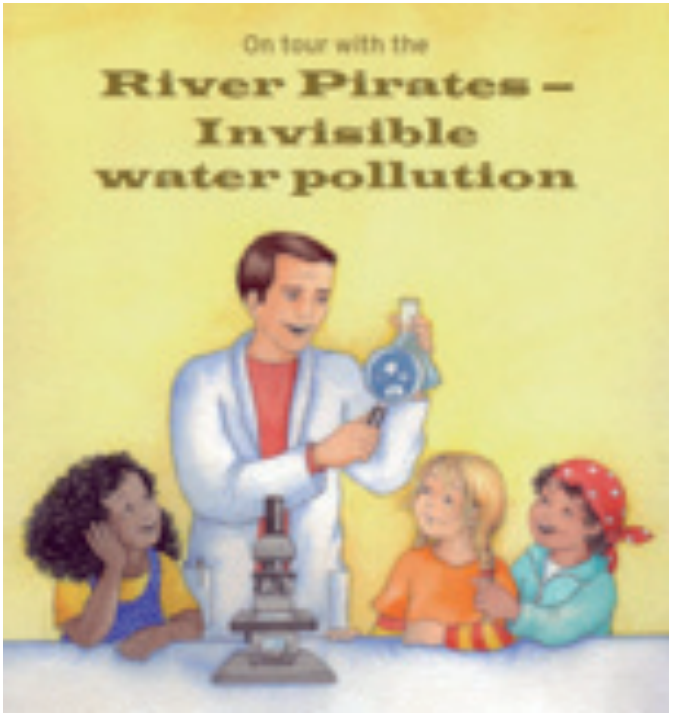
4. Überlegen Sie bei eher harmlosen Beeinträchtigungen, ob eine Medikamenteneinnahme wirklich sinnvoll und eine sanftere Alternative nicht ebenso hilfreich ist.

5. Fragen Sie Ihren Arzt oder Apotheker nach umweltverträglichen Alternativen.

Die Initiative „Den Spurenstoffen auf der Spur in Dülmen" (DSADS) wurde als Pilotprojekt von der Landesregierung, der Stadt Dülmen und dem Lippeverband ins Leben gerufen und erforscht, inwieweit sich die Gewässerbelastung mit Arzneimittelrückständen durch Aufklärung und den Dialog mit Bürgern, Apothekern und Ärzten reduzieren lässt. Weitere Informationen finden Sie im Internet auf **www.dsads.de**

Kontakt: Stadt Dülmen · Reinhild Kluthe · Telefon: 02594 / 12-870 · E-Mail: kluthe@duelmen.de
LIPPEVERBAND · Dr. Issa Nafo · Telefon: 0201 / 104-0 · E-Mail: nafo.issa@eglv.de

Info campaign of the Lippeverband (D), flyer attached to the annual "waste calendar" distributed to every household by the municipality Dülmen



noPILLS mini book for children, published in 8 languages

BioIS-Theme 8: Implementing incentive economic instruments (noPills report Chapter 2 and 4)

- People have little or no understanding on the cost that would be involved in advanced wastewater treatment and may be more prepared to change disposal behaviour if they were;
- Appropriate pack sizes may reduce medicine wastage;
- Insurers should be involved in discussion about reimbursement of environmentally friendly alternatives such as non-medicine treatments or 'greener' medicines;
- Although price is a factor in purchasing decisions, its influence is ambiguous: a high price could make a product either more or less attractive to buy. Price control might not necessarily be a useful driver for behaviour change with regards to OTC medicine purchasing and hence might a be a problematic 'intervention point' (although maybe for other stakeholders).

BioIS-Theme 9: Developing the knowledge base through fostering of research activities (noPILLS project overall as a joint research project with a focus on multi-disciplinary work)

- It is recommended to undertake a thorough similar exploration of perceptions at the outset of inter- or multidisciplinary projects to ensure all participants and stakeholders are engaged as the project progresses and that such reflections continue throughout the project.

The noPILLS partnership sees this theme as an opportunity to reflect on its own 'performance' as a multi-disciplinary and international research colloquium (that was supported by an equally multi-disciplinary and international advisory board). Multidisciplinary cooperation is needed to find solutions for complex problems such as that of pharmaceuticals in the environment and the noPILLS partnership offered the reflections on their own working as a contribution to the final report, too.

noPILLS final conference – impressions and feedback

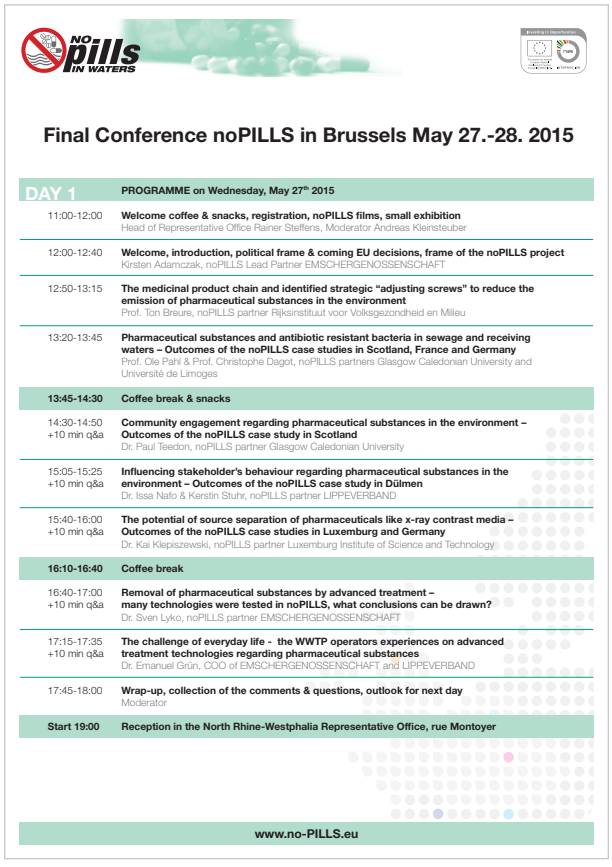
On May 27th / 28th 2015 the noPILLS final conference was held in Brussels, in the German North Rhine-Westphalian Representative Office.

On the first day the noPILLS partners presented their project outcomes, joint findings and identified gaps and challenges that have been addressed in the final report. Important messages following from these presentations and feedback from the audience were:

- Traces of pharmaceuticals are found in ecosystems and drinking water sources.
- Possible ecological effects are acknowledged.
- The spread of antibiotic-resistant germs is a current concern and will eventually become a huge problem in terms of public health.
- Special substances demand special solutions: targeted measures can be identified for specific groups of compounds.
- Costs: how much and who takes responsibility/pays?
- Which legal demands will be established and where? At the moment solutions applied are voluntary.
- Stakeholder awareness and public awareness are both important, and can be influenced.
- No silver bullet identified, but actions are identified for all stakeholders in the entire medicinal product chain.

The second day was dedicated to the political follow-up: Which conclusions can be drawn from the insights obtained, and what is the government in the involved partner countries planning to do to avoid pharmaceutical residues in the water?

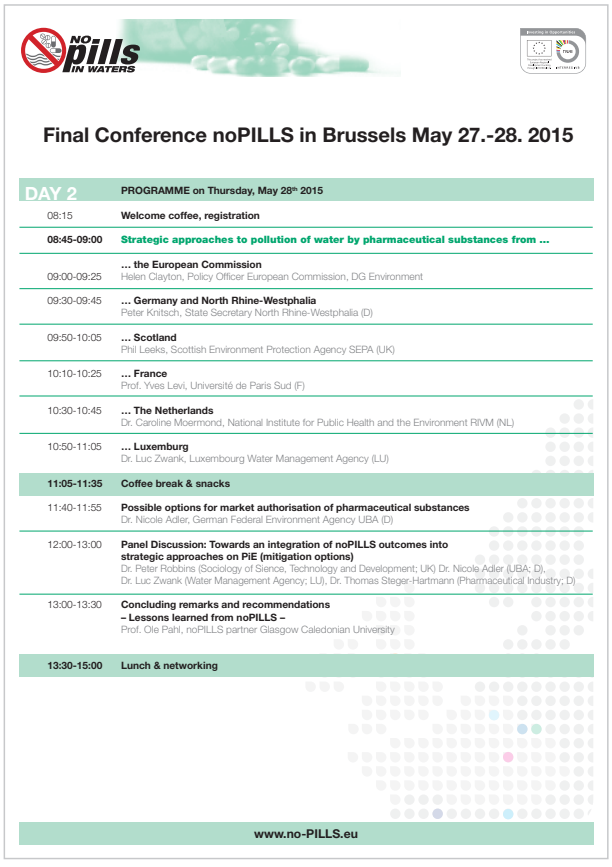
Moreover, the need to take action was seen in the bigger picture; the elimination from water should not lead to more pharmaceuticals in (sewage) sludge, landfill sites or agricultural land with the risk of transferring problems from one environmental compartment to another. In general, the aim is “less pharmaceuticals in the environment” and how to achieve this goal in the EU member states.



Final Conference noPILLS in Brussels May 27.-28. 2015

DAY 1	PROGRAMME on Wednesday, May 27th 2015
11:00-12:00	**Welcome coffee & snacks, registration, noPILLS films, small exhibition** Head of Representative Office Rainer Steffens, Moderator Andreas Kleinsteuber
12:00-12:40	**Welcome, introduction, political frame & coming EU decisions, frame of the noPILLS project** Kirsten Adamczak, noPILLS Lead Partner EMSCHERGENOSSENSCHAFT
12:50-13:15	**The medicinal product chain and identified strategic “adjusting screws” to reduce the emission of pharmaceutical substances in the environment** Prof. Ton Breure, noPILLS partner Rijksinstituut voor Volksgezondheid en Milieu
13:20-13:45	**Pharmaceutical substances and antibiotic resistant bacteria in sewage and receiving waters – Outcomes of the noPILLS case studies in Scotland, France and Germany** Prof. Ole Pahl & Prof. Christophe Dagot, noPILLS partners Glasgow Caledonian University and Université de Limoges
13:45-14:30	**Coffee break & snacks**
14:30-14:50 +10 min q&a	**Community engagement regarding pharmaceutical substances in the environment – Outcomes of the noPILLS case study in Scotland** Dr. Paul Teedon, noPILLS partner Glasgow Caledonian University
15:05-15:25 +10 min q&a	**Influencing stakeholder’s behaviour regarding pharmaceutical substances in the environment – Outcomes of the noPILLS case study in Dülmen** Dr. Issa Nafo & Kerstin Stuhr, noPILLS partner LIPPEVERBAND
15:40-16:00 +10 min q&a	**The potential of source separation of pharmaceuticals like x-ray contrast media – Outcomes of the noPILLS case studies in Luxemburg and Germany** Dr. Kai Klepiszewski, noPILLS partner Luxemburg Institute of Science and Technology
16:10-16:40	**Coffee break**
16:40-17:00 +10 min q&a	**Removal of pharmaceutical substances by advanced treatment – many technologies were tested in noPILLS, what conclusions can be drawn?** Dr. Sven Lyko, noPILLS partner EMSCHERGENOSSENSCHAFT
17:15-17:35 +10 min q&a	**The challenge of everyday life - the WWTP operators experiences on advanced treatment technologies regarding pharmaceutical substances** Dr. Emanuel Grün, COO of EMSCHERGENOSSENSCHAFT and LIPPEVERBAND
17:45-18:00	**Wrap-up, collection of the comments & questions, outlook for next day** Moderator
Start 19:00	**Reception in the North Rhine-Westphalia Representative Office, rue Montoyer**

www.no-PILLS.eu

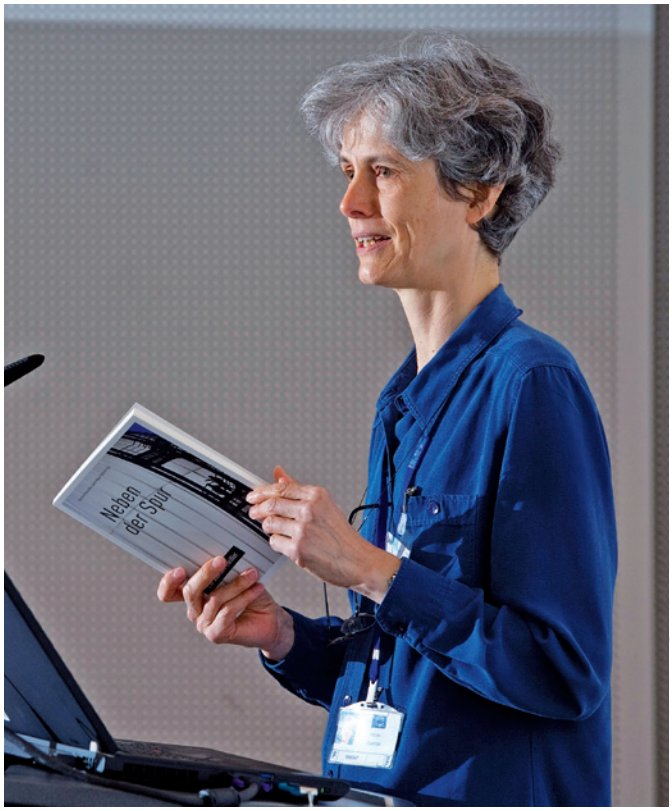


Final Conference noPILLS in Brussels May 27.-28. 2015

DAY 2	PROGRAMME on Thursday, May 28th 2015
08:15	**Welcome coffee, registration**
08:45-09:00	**Strategic approaches to pollution of water by pharmaceutical substances from ...**
09:00-09:25	**... the European Commission** Helen Clayton, Policy Officer European Commission, DG Environment
09:30-09:45	**... Germany and North Rhine-Westphalia** Peter Knitsch, State Secretary North Rhine-Westphalia (D)
09:50-10:05	**... Scotland** Phil Leeks, Scottish Environment Protection Agency SEPA (UK)
10:10-10:25	**... France** Prof. Yves Levi, Université de Paris Sud (F)
10:30-10:45	**... The Netherlands** Dr. Caroline Moermond, National Institute for Public Health and the Environment RIVM (NL)
10:50-11:05	**... Luxemburg** Dr. Luc Zwank, Luxembourg Water Management Agency (LU)
11:05-11:35	**Coffee break & snacks**
11:40-11:55	**Possible options for market authorisation of pharmaceutical substances** Dr. Nicole Adler, German Federal Environment Agency UBA (D)
12:00-13:00	**Panel Discussion: Towards an integration of noPILLS outcomes into strategic approaches on PiE (mitigation options)** Dr. Peter Robbins (Sociology of Sience, Technology and Development; UK) Dr. Nicole Adler (UBA: D), Dr. Luc Zwank (Water Management Agency; LU), Dr. Thomas Steger-Hartmann (Pharmaceutical Industry; D)
13:00-13:30	**Concluding remarks and recommendations – Lessons learned from noPILLS –** Prof. Ole Pahl, noPILLS partner Glasgow Caledonian University
13:30-15:00	**Lunch & networking**

www.no-PILLS.eu

Helen Clayton, Policy Officer, European Commission, DG Environment, summarised the EU's progress to date on developing a strategic approach to the pollution of water by pharmaceutical substances as required by Directive 2013/39/EU. Although there would be a few months' delay, plans had been made to gather additional information to support the work. Helen Clayton stressed the value to the Commission of inputs from research projects such as noPILLS, and welcomed the commitment of the scientists and practitioners involved to continue working on the issue in their regions. The challenge is always to translate research findings into policy. The approaches discussed in the noPILLS project already show that a wide range of tools across various sectors and timescales is needed, and that raising awareness among all relevant stakeholders including producers, healthcare professionals and patients will be particularly important.



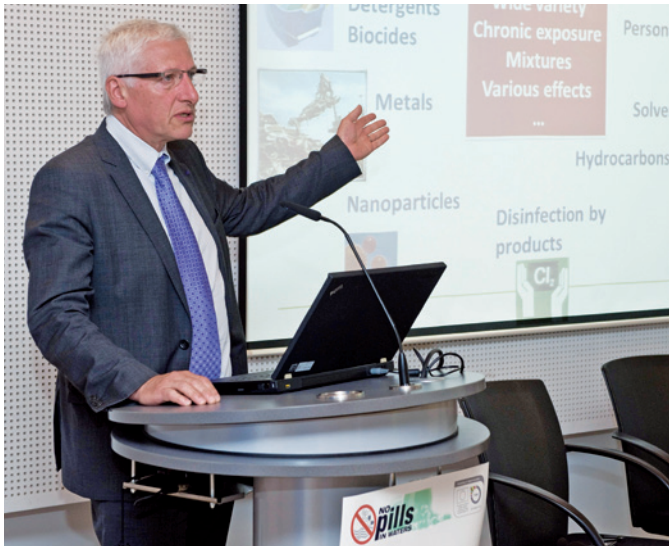
The noPILLS project has demonstrated the effectiveness of awareness raising in influencing behaviour; experience in other areas such as recycling confirms that children can be particularly effective at communicating messages to their parents. It's important that we all "speak the same language", for example by using commonly understood words or simple logos in product leaflets. We shouldn't forget about the influence of lifestyle on people's health, and the possibility of reducing the need for treatment – and thus emissions to water - by living more healthily."

Peter Knitsch, State Secretary in the Environment Ministry in North Rhine-Westphalia (NRW)/Germany, pointed out the special feature this Federal State has. Here pharmaceuticals are in general seen in the wider frame of micro pollutants that also for example from household chemicals, brownfields, agriculture or industry. In NRW the cooperation within the International Commission for the Protection of the Rhine (ICPR) plays a leading role on strategic approaches and hereby for the transnational policy, too. The NRW environment policy is – besides education and legal measures regarding certain substances – very much focusing on treatment technologies at the source and in municipal treatment facilities.

"For precautionary reasons we need to start with multi-barrier-principles today already. We are aware that this causes far higher costs. But on the other hand: Which corporate costs will it cause if we don't take action?"

Phil Leeks from the Scottish Environment Protection Agency SEPA explained the Scottish network that supports the work on pharmaceutical residues, with the primary aim to identify the problem, available data and possible hot spots in order to develop abatement strategies where applicable.

"Detailed sewer catchment investigations enable us to better understand where pharmaceutical substances arise. We need to identify the most appropriate solutions to prevent pharmaceuticals entering the water environment, these should be source orientated rather than end-of-pipe treatment."



Prof. Yves Levi, Université de Paris Sud, outlined key aspects of the public perception of pharmaceuticals in the environment within France. National initiatives, jointly governed by the Ministry of Health and the Ministry of Environment still leave several gaps to close in addressing the 2011. Both jointly elaborate strategies but to set up the 2011 decided national action plan (to reduce pharmaceuticals in water) there are. Moreover, addressing the wider public in order to achieve awareness and behaviour changes is difficult as the press often simplifies the background stories.

"In these growing markets of pharmaceuticals and many other chemical compounds that enter the water we have to communicate very precisely what receiving environment we talk about, who bears responsibility and which threshold values to meet where. In public the most attention is paid whenever tap water is mentioned."

Dr. Caroline Moermond, National Institute for Public Health and the Environment RIVM (NL), stressed that the Netherlands are in a special situation as they are the "receiving environment" regarding water coming from the Rhine and Meuse catchments.

"We already work in the spirit of the noPILLS approach. The Netherlands try to solve problems with a "round table approach" that involves all actors. Moreover, we have examples where an integrated way of thinking has shown that what is good for the environment can also have positive side effects for public health. That's also a way to manage the cost-benefit discussion."

Dr. Luc Zwank, Luxembourg Water Management Agency (LU), is also representative in working groups of the International commission for the Protection of the Rhine and therefore he is very familiar with transnational strategies.

"Our Luxemburgish strategy is going into a "no regret" direction at the moment, for example reserving space on the new sites of waste water treatment plants in order to have space when we once come to decisions about advanced treatment needs. We are hoping for an EU frame within the Water Framework Directive to guide the elimination demands."

Possible options for market authorisation of pharmaceutical substances

Dr. Nicole Adler, German Federal Environment Agency UBA (D), summarized the current legal situation and the need to take action regarding the legislative frame.

„We have identified a number of regulatory gaps. For example by now, even if a new substance is known to be environmentally problematic, no refusal of the product is possible. A comprehensive environmental assessment is available for 200 pharmaceutical ingredients. For some hundred out of those pharmaceuticals with market authorization permitted before 2006 there has no environmental assessment been performed. To close this gap we urgently need better data and legislative changes."

Panel Discussion: Towards an integration of noPILLS outcomes into strategic approaches on Pharmaceuticals in the Environment

Key messages of the panel discussion

Dr. Peter Robbins, Sociology of Sience, Technology and Development (UK)

"Public science and technology engagement campaigns have sometimes been overtaken by interest groups, which has meant that issues have become polarised. Our research on the UK GM crops debate found that public attitudes on science-based issues was shaped more by the source of the information than the content. As such, we found that public trust in sources of information is important and is built over time. So the message is important, but also its source."

Dr. Nicole Adler, UBA (D)

"Even if we don't see any threat by now – long term we have to estimate there will be problems we simply cannot imagine now. The cocktail is difficult to assess and to communicate."

"For bottled water there are threshold values that don't exist for tab water."

Dr. Luc Zwank, Water Management Agency (LU),

"We are all benefitting from newly developed substances but all of them will end up somehow in the environment. So it is again looking at the whole life cycle and the cost-benefit ratio. But in the end we are not prepared to work constantly, we always have to react to shots coming from somewhere."

Dr. Thomas Steger-Hartmann, Bayer HealthCare (D), representing the Pharmaceutical Industry:

"Concerning drinking water, we can exclude a risk for human health in Europe, however, there may be an impact on aquatic species in surface waters receiving large volumes of effluent from sewage treatment plants."

"We do have many substances on the market for decades now, they are well monitored and the traces we find are not problematic for humans, even if bioaccumulation might occur in some aquatic species."

“Which actions to take - my priorities”

Dr. Thomas Steger-Hartmann

“We need to close the data gaps for substances permitted before 2006.”

“We also need to assess the release from pharmaceutical manufacturing sites, particularly in less developed countries, where sewage treatment does not necessarily meet European standards.”

“If we manage to have end-of-pipe solutions for a costs increase of up to 10% it is a good contribution to the reduction of many residues in the aquatic environment.”

Dr. Luc Zwank

“In general I agree to the mentioned priorities. The challenge is to have the right measure at the right place and a consideration of interdependencies.”

Dr. Nicole Adler

“There is a need to address every step of the life cycle and think both short and long term.”

Dr. Peter Robbins

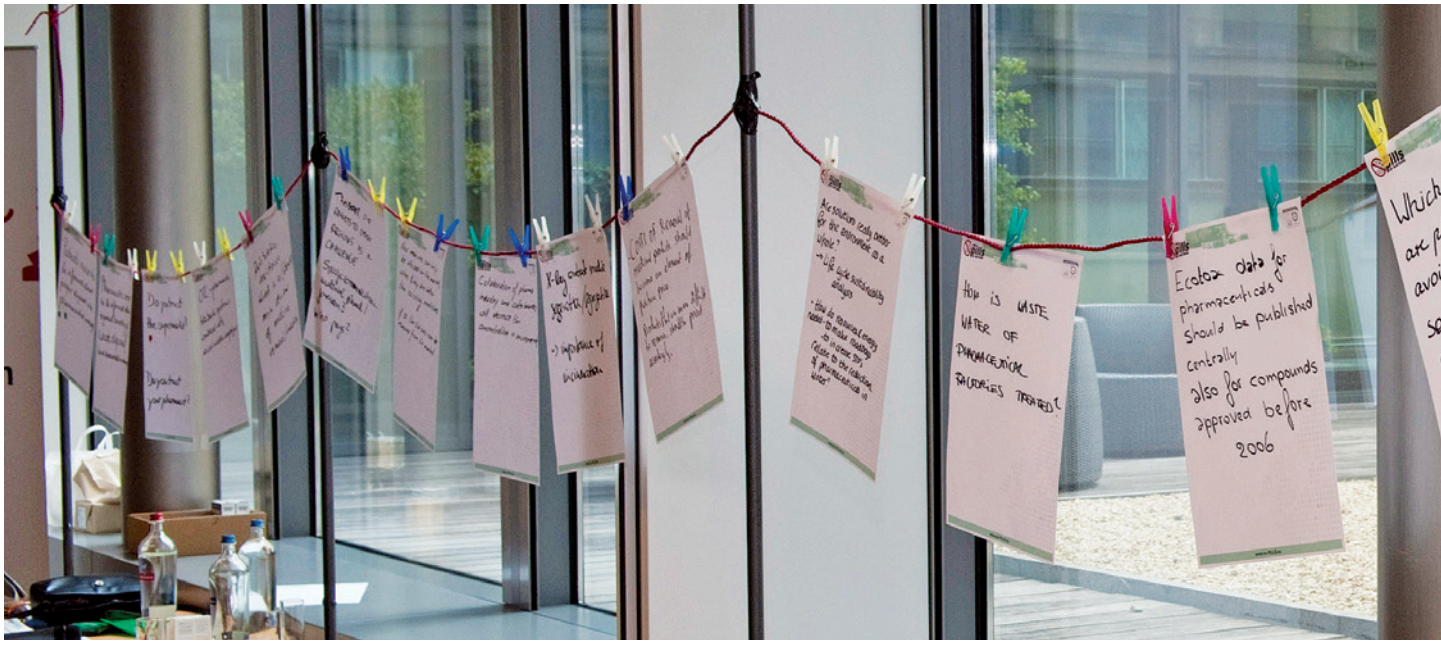
“It is important to involve economists as a next step in this work. They can carry out cost-benefit analysis and willingness to pay surveys. It is important to think about how best to engage publics. It is not always about simply providing scientific information; how the information is provided, by whom and at what stage are all important considerations.”

Remark:

The final report was printed as a conference version for the May 27th / 28th 2015 symposium and it was announced at the conference that additional inputs and photos would be collected and added to the version that is now disseminated via the webpage www.no-PILLS.eu.

This final report is only summarizing a part of the project work; scientific publications will follow hereafter. We are grateful for further support and all participating partners are happy to answer questions and impart knowledge.

Feedback from the audience – comments and questions



Patients need to be informed about proper disposal via pharmaceutical industry	Pharmacists need to be informed about regional handling of waste disposal (and disseminate to customers)	When I'm drinking water I have no choice in case there are substances in it. Informing public is about enabling them to choose.	Are solutions really better for the environment as a whole? -> Life cycle sustainability analysis
Can we group compounds and look into the product chain: where and how is elimination useful?	How do resources and energy needed (to make roadbags or to increase waste water treatment plants) relate to the reduction of pharmaceuticals in water?	If we go for the "single compounds approach" we are always behind.	Costs of removal of medicinal products should become an element of purchase price. Products that are more difficult to remove should be priced accordingly.
How is waste water of pharmaceutical factories treated?	Public knowledge about water is poor in general, so public debates should be well organized to avoid developments like about climate change where trust in stakeholders gets lost and everyone points to another.		There are promising approaches – a public-private-partnership between the pharmaceutical industry, the European Commission and regulatory administrations

Which strategies are planned to avoid problems from sewage sludge?	X-ray contrast media separation/segregation -> importance of incineration	Ecotox data for pharmaceuticals should be published centrally also for compounds approved before 2006	New medicines can only be allowed on the market, when they are better than existing medicines. If so the old ones can be removed from the market.
Antibiotic resistance threat is a (should) main driver of medicines removal / reduction.	Transfer of results to other regions as a challenge. Specific communication material planned / foreseen? Who pays?	Do you trust the supermarket? Do you trust your pharmacist?	OTC and pharmacies take back systems combined with social media campaigns
Which role play pharmacists in advice, in the sales talk in comparison to super markets, for disposal habits?	Collaboration of pharma industry and water boards will decrease the concentration in environment	Which strategies are planned or needed to avoid a transfer from one environmental medium to another, for example eliminating substances from waste water but finding them later in sewage sludge or on waste disposal sites?	

NO pills IN WATERS

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Impressum

EMSCHERGENOSSENSCHAFT

Kirsten Adamczak
Kronprinzenstrasse 24
45128 Essen, Germany

Phone: 0049 - 201 104 2679
E-mail: adamczak.kirsten@eglv.de

www.no-pills.eu

edition June 2015