



WHO Collaborating Centre for Health Promoting Water Management and Risk Communication Institute for Hygiene and Public Health University of Bonn



Occurrence of antibiotics in hospital wastewater, municipal wastewater and surface waters

Antibiotics and other pharmaceuticals are widely used in both human medical care and for veterinary purposes. In recent years there has been a growing interest in the determination of these compounds in the aquatic environment, but there is still insufficient data for an improved risk assessment of these substances. Some important results concerning the concentrations of pharmaceuticals in the environment are given in several reports (Alder et al 2001, Heberer 2002, Hirsch et al 1999, Kümmerer 2001, Sacher et al 2001, Ternes et al. 2001).

Especially the existence of antibiotics in the environment is discussed to contribute to the reported increase of antibiotic resistance concerning several human pathogen microorganisms (e.g. MRSA, VRE) (Witte 1999).

As part of the hospital complex of the University of Bonn, we used the data of the clinical pharmacy to calculate the amounts of the most administered antibiotics within the hospital area. We developed an analytical method for the simultaneous determination of these compounds in the untreated wastewater of the hospital as well as in the municipal wastewater of sewage treatment plants and in surface waters like water of the river Rhine at several points.

Furthermore, we determined the concentrations in bank filtration and lake waters, used for the production of drinking water.

In addition, several antibiotics used outside the hospital complex (public health area), which were also found in the wastewater of the treatment plants, were added to the analytical program.

29 different compounds of different classes including macrolides, sulfonamides, penicillines, tetracyclines and chinolones were determined using a LC-MS/MS system (Agilent 1100 / Applied Biosystems, API 2000, ESI).

Sample treatment consisted of filtration and SPE, using Baker SDB and Waters Oasis material at pH 4, with special elution conditions.

LC chromatography used polar endcapped C18-phases, starting with 100% water eluent.

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Recovery rates ranged reproducible between 60 % and 110 %, and detection limits were 0,5 - 2 ng/l for most macrolides, 2- 10 ng/l for the most of the other compounds, up to 50 ng/l for vancomycin.

The following table presents the average sum concentrations (as median values in microgram/L) in the specific water compartments:

Table 1: Average sum concentrations

| Analyte | average sum concentrations (as median values in microgram/L) | | | | | |
|------------------|--|---------------------------------------|---------------------------------------|------------------------------|-----------------------|-----------------------------------|
| | Clinical waste water | Influents waste water treatment plant | Effluents waste water treatment plant | Surface waters (River Rhine) | Bank filtration water | Surface water (storage reservoir) |
| Penicillines | 0.26 | 0.06 | 0.095 | 0.003 | < LOD | < LOD |
| Macrolides | 3.2 | 0.74 | 1.17 | 0.028 | 0.023 * | 0.003 – 0.03 |
| Fluoroquinolones | 14.7 | 0.33 | 0.038 | 0.002 | < LOD | < LOD – 0.004 |
| Sulfonamides | 8.0 | 1.0 | 0.24 | 0.040 | 0.011 | 0.001 – 0.02 |
| Trimethoprim | 2.7 | 0.18 | 0.014 | 0.005 | < LOD | < LOD – 0.004 |
| Tetracyclines | 0.13 | 0.032 | < LOQ | < LOD | < LOD | < LOD |
| Vancomycin | 0.65 | 0.052 | < LOQ | < LOD | < LOD | < LOD |
| Total | 29.6 | 2.39 | 0.56 | 0.078 | 0.011 | 0.001 – 0.04 |

(LOD = limit of detection, LOQ = limit of quantification)

* only Erythromycin

The most relevant analytes were Piperacillin, Ciprofloxacin, Clindamycin, Sulfamethoxazole and some macrolides like Erythromycin, Clarithromycin and Roxithromycin.

In drinking waters, stemming from surface waters or bank filtration waters, no antibiotics were detectable.

The growing amount and the possible reasons of antibiotic resistant microorganisms in waste water contaminated with antibiotic pharmaceuticals was examined by the BMBF (Wiethan 1999). The final report of this project is to be expected in late summer 2003. From the view of environmental hygiene it cannot be excluded with the present level of knowledge that permanent low concentrations of antibiotics in waste water or in waste water- influenced surface waters like rivers may lead to antibiotic-resistant microorganisms. Our own investigations showed that *Enterobacter cloacae* with uniform genotype (determined by pulse field gel electrophoresis) can spread across a distance of more than 70 km in surface waters and can lead to a contamination of drinking water treatment plants and can even be found in drinking water. These are reliably exceptional cases, which must, however, be considered in further discussions about spreading of antibiotic-resistant microorganisms in the environment.

This work was supported by the Environmental Department (Landesumweltamt Duesseldorf) of the federal state of North Rhine-Westphalia, Germany; Title: Untersuchung von Krankenhausabwässern des Universitätsklinikums Bonn (UKB), von kommunalem Abwasser sowie von Oberflächenwasser und Uferfiltraten auf Rückstände ausgewählter Antibiotika, Nr. LUA NRW 112-1781/MZ 43/99, 112-1781/MZ).

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Recent projects of the WHO CC

Training in surveillance of water-related diseases

University of Bonn, Germany, 22-29 June 2003

The meeting was organized by the WHO Collaborating Centre for Health Promoting Water Management and Risk Communication, with the coordination of the Water and Sanitation (WSN) programme of the WHO regional office for Europe. Funding was provided through the multicountry programme on gastro-intestinal diseases and water supply systems of the Division of Country Support in the WHO Regional office for Europe.

The meeting was unique in the context of the WSN programme since for the first time all Central Asian republics (CAR): Kazakhstan, Uzbekistan, Tajikistan and Turkmenistan took part in a programme held at the WHO Collaborating Centre for Health Promoting Water Management and Risk Communication. Besides, participants from the CAR region, the Institute for Hygiene and Public Health (University of Bonn, Germany, the Federal Environmental Agency and the Emroy University (USA) were also represented.

The main topics discussed during the meeting were:

- National priorities in decreasing water-related disease burden in the CAR
- Water monitoring strategies for chemical and microbial pollution
- Detection and investigation of waterborne disease outbreaks
- Evaluation of a surveillance system
- Assessment of water supply structures
- WHO water safety plans

A special focus was put on the question of how existing surveillance systems can be evaluated and improved to address the disease burden associated with water-related diseases, which is currently seriously under-estimated. The Geographic Information System (GIS) offers a unique new potential to link environmental and health information in one integrated system to protect human health.

The meeting resulted in a number of proposals to be taken up in the design of the new biennial work plan. Amongst these

- the assessment of the level of infections by protozoic parasites *Giardia Intestinalis* and *Cryptosporidium* in Central Asia;
- the assessment of the current sanitary inspection Saniped Systems;
- the development of a manual for water-related disease surveillance;
- the translation of guidance material, particularly the material related to waste and wastewater application in agriculture.

Virtual Learning Environments for Medical Geography: An analysis of courses offered in the Internet

As already reported in the last edition of this newsletter, the development of a new "Medical Geography" e-learning course is on the way.

In preparation of the development, an intensive Internet research was carried out to identify the already available Virtual Learning Environments (VLE) and e-learning courses for Medical Geography.

The basic components of a VLE are shown in Fig. 1. Virtual learning is similar to on-class learning, but all communication and administration is done electronically.

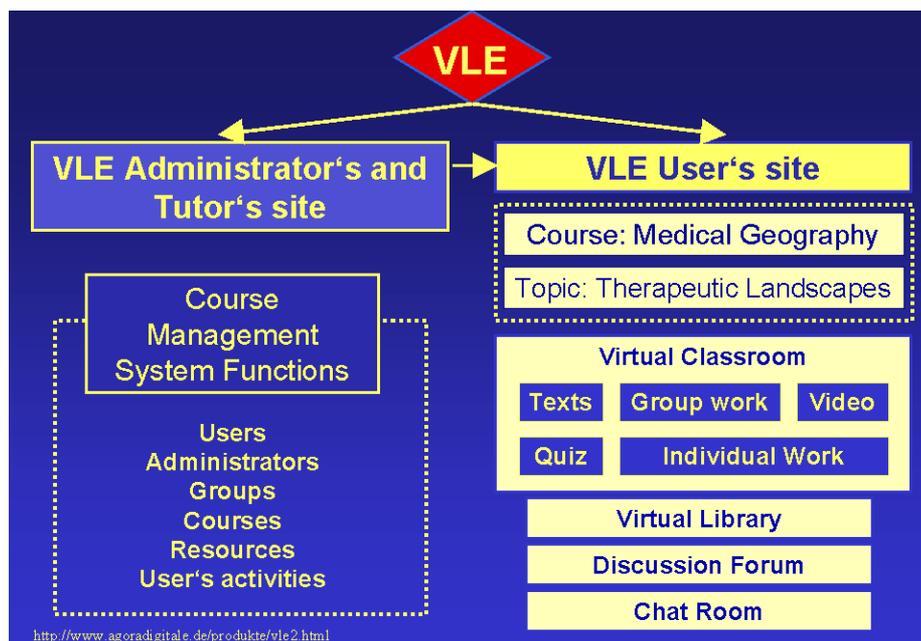


Fig. 1: Constituents of a Virtual Learning Environment

This analysis was conducted using several search engines with key words such as: "medical geography" in combination with "distance learning", "e-learning", "virtual learning environment", "geographic information systems", "public health" and "epidemiology". The courses identified were examined mainly in terms of access, costs, required certificates, quality control, and their pedagogical and technical approaches.

The results identified several internet courses offering medical geography, almost all provided by universities. Most of these courses were text based, with limited practical applications. It appears that few courses have aspects of medical geography embedded in a virtual learning environment. These VLE courses usually enable students to acquire certificates, they are, however, very expensive and require sophisticated technologies. Aspects such as quality control and evaluation were not clearly identified in most cases. This internet investigation indicated shortcomings in medical geography courses embedded in virtual learning environments.

The results of this Internet research will be taken into account for the development of the new virtual medical geography course developed by the WHO CC.

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- <http://whatis.techtarget.com>
- <http://www.agoradigitale.de/produkte/vle2.html>
- http://www.hlst.ltsn.ac.uk/projects/specialists/erskine_glossary.html

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Special Events

2003

Hydro 2003 International Conference & Exhibition 3-6 November 2003 Hotel Croatia, Cavtat, Dubrovnik

The Hydro 2003 Conference & Exhibition will provide an opportunity to gain first-hand experience of development opportunities in the Central and Eastern European region, and also to discuss plans, progress and challenges for hydropower worldwide, during the Technical sessions. Over 500 participants: private developers, utilities, planners, financiers, consultants, researchers, environmental specialists, powerplant operators and manufacturers from more than 50 countries are expected to attend.

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Ecohazard 2003: 4th Specialised Conference on Assessment and Control of Hazardous Substances in Water 14-17 September 2003 Aachen, Germany

The risk of ecohazards has never been more present than today. We face an unprecedented challenge yet at the same time we have at our disposal unforeseen opportunities for better risk management which can decisively lessen the influence and damages caused by chemical compounds or their degradation products. In meeting this aim, natural scientists and engineers alike can contribute a sustainable element to environmental safety.

Contact: Dr. H. Fr. Schroeder
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E-mail: iwa-ecohazard2003@isa.rwth-aachen.de
Web: <http://www.ecohazard2003.rwth-aachen.de/main.html>

Water: Key to Sustainable Development in Africa 14-19 September 2003 Cape Town, South Africa

The aim of the Cape Town Conference is to bring the best available expertise in the world to Africa in order to share experience and technology with the developing world.

Contact: Heidi Olivier
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E-mail: lolivier@med.up.ac.za
Web: <http://www.iwaconferences.co.za/Pages/Home.html>

Symposium on Health-Related Microbiology 14-19 September 2003 Cape Town, South Africa

The Symposium basically addresses waterborne diseases in a broad sense.

Waterborne diseases have been identified by the World Health Organization, World Bank, UNESCO, and others, as one of the most important health concerns of the world.

The Symposium forms part of a number of events in a Conference entitled "Water as the Key to Sustainable Development in Africa".

For further information please contact: Ray Morris: hrwm.capetown@ntlworld.com

Future Events

2004

et2004
Mar. 30-Apr. 1, 2004
NEC, Birmingham, UK

The UK's premier environmental technology & management services exhibition.

Technical Field: Wastewater Treatment
Environmental Management
Air Quality
Health & Safety
Water Resources
Waste/Recycling
Soil & Groundwater

Contact: Exhibitions Team
Phone/Fax: Tel: 0044 (0) 208 651 7100; Fax: 0044 (0) 208 651 7117
E-mail: exhibit@fav-house.com
Web: <http://www.et-expo.co.uk>

International Conference on Automation in Water Quality Monitoring - AutMoNet 2004
19-20 April 2004
Vienna, Austria

There is an increasing need for water quality information systems. These systems are mainly based on automated measurement devices. In order to discuss the state of the art and the future possibilities the main objective of the conference is to enhance the dialogue between water specialists, plant operators, chemists and instrument suppliers. This interdisciplinary dialogue is essential for the development of solutions for water quality management.

The scientific program of AutMoNet 2004 will cover a wide range of topics from leading edge sensor technology, wise use of novel technology, data to information transfer, successful end-user applications in municipal water quality management, environmental monitoring, to water system security.

Contact: Günter Langergraber
E-mail: autmonet2004@boku.ac.at
Web: <http://iwga-sig.boku.ac.at/autmonet/>

6th International Trade Fair and Congress "Water: Ecology and Technology" -
ECWATECH-2004
1-4 June 2004
Russia, Moscow

Water resources (surface and ground water), Water supply, Water disposal and wastewater treatment, Economics and law, Environmental monitoring of water works

Technical Field: Water Resources Environmental Management Wastewater Treatment

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Fourth Ministerial Conference on Environment and Health
23-25 June 2004
Budapest, Hungary

The Budapest Conference is the fourth in a series started in 1989, bringing together ministers of health and of environment and major stakeholders. European ministers are expected to reach consensus and make political commitments to ensure safer environments for children through the adoption of a Conference Declaration and of the European action plan for children's health and environment (CEHAPE).

River Flow 2004
23-25 June 2004
Naples, Italy

River valleys have been the first places to develop a human civilization. They still are among the most populated areas on earth. Human activities are sometimes a threat to the rivers health, but the rivers are as often a resource as are a hazard to riverside communities. The need for observation, analysis and control of fluvial processes has thus increased dramatically. River Hydraulics is more than ever needed to guide engineering works, evaluate environmental impacts, and mitigate hazards. At the same time, new knowledge is developed from advances in physical understanding, computational methods and measurement techniques, and by the integration with modern technologies. Researchers involved in these developments are cordially invited to attend River Flow 2004. Organised under the auspices of the Fluvial Hydraulics and Eco-Hydraulics Sections of the International Association of Hydraulic Engineering and Research (IAHR), this international conference will constitute a forum for all scientists and engineers working for a better understanding of river hydraulics processes. The conference will cover both hydrodynamic and sediment related phenomena.

Technical Field: Water Resources

Soil & Groundwater

Contact: Massimo Greco

Phone/Fax: Tel: +39-081-7683427

Web: <http://www.studioesse.net/river/>

Aquatech Amsterdam 2004
Sep. 28-Oct. 1, 2004

Amsterdam RAI Exhibition and Conference Centre, Amsterdam, The Netherlands

Aquatech Amsterdam 2004 is the place for you to meet water professionals from all over the world who wish to keep abreast of all the latest developments in the water market. Aquatech, the international trade event for water technology and water management, will as always provide the best possible surroundings in which to make new contacts and renew existing ones. At Aquatech Amsterdam 2004 you can present your products and services to technically oriented professionals and policy-makers from government and industry. At Aquatech Amsterdam 2004 different national and international target groups will be presented on a segmented basis.

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New books and articles

Farley, M. and S. Trow (2003): *Losses in Water Distribution Networks- A Practitioner's Guide to Assessment, Monitoring and Control*. IWA Publishing.

Henderson, A.J. (2003): *The E-Learning Question and Answer Book: A Survival Guide for Trainers and Business Managers*, American Management Association, New York.

Lens, P., O'Flaherty, V., Moran, A.P., Stoodley, P. and T. Mahony (Eds) (2003): *Biofilms in Medicine, Industry and Environmental Biotechnology- Characteristics, Analysis and Control*. IWA Publishing.

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Vesilind, P.A. and R.L. Rooke (Eds) (2003.): *Wastewater Treatment Plant Design*. IWA Publishing.

Wilderer, P.A., Zhu J., Schwarzenbeck, N.(Eds) (2003.): *Water in China*. IWA Publishing.

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Wuertz, S., Bishop, P.L., Wilderer, P.A. (Eds) (2003): *Biofilms in Wastewater Treatment- An Interdisciplinary Approach*. IWA Publishing.

Links

WHO Collaborating Centre for Health promoting Water Management and Risk Communication

<http://www.meb.uni-bonn.de/hygiene/who/whocc.htm>

WHO Europe Water and Sanitation Homepage

<http://www.euro.who.int/watsan>

TechTarget

<http://whatis.techtarget.com>

Synergie Agora Digitale

<http://www.agoradigitale.de/produkte/vle2.html>

Learning and teaching support network

http://www.hlst.ltsn.ac.uk/projects/specialists/erskine_glossary.html

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