Seminarium i Almedalen 30 juni 2015

Vad gör vi åt läkemedelsrester i våra vatten? Kommer Bryssel lösa problemet?

#vattenläkemedel

SIWI SWEDISH WATER HOUSE

Medverkande

#vattenläkemedel

- **Torgny Holmgren**, VD, SIWI
- **Bengt Mattson**, Miljöansvarig, Pfizer; Läkemedelsindustriföreningen LIF.
- **Marlene Ågerstrand**, Forskare, Stockholms Universitet MistraPharma
- **Pauline Göthberg**, Nationell Samordnare för Socialt Ansvarstagande i Offentlig Upphandling, Stockholms Läns Landsting
- **Cecilia de Pedro**, Miljöchef, Apotek Hjärtat
- **Kristina Yngwe**, Riksdagsledamot, Centerpartiet
- **Emma Nohrén**, Riksdagsledamot, Miljöpartiet
- **Nicolai Schaaf**, Swedish Water House/SIWI

Swedish Water House klustergrupp om

Vatten och Läkemedel

Nicolai Schaaf

Stockholm International Water Institute

SIWI

www.siwi.org

THE PHARMA TRANSPORT TOWN:

UNDERSTANDING THE ROUTES TO SUSTAINABLE PHARMACEUTICAL USE

Dr Will Stahl-Timmins | Dr Clare Redshaw | Dr Mathew White | Prof Michael Depledge | Prof Lora Fleming

European Centre for Environment & Human Health
University of Exeter Medical School

Funded by:
EUROPEAN UNION Investing in Your Future European Regional Development Fund 2007-13
European Union European Social Fund Investing in jobs and skills
convergence for economic transformation

WINNER PEOPLE'S CHOICE POSTERS & GRAPHICS
INTERNATIONAL SCIENCE AND ENGINEERING VISUALIZATION CHALLENGE 2012

AS PUBLISHED IN *SCIENCE*:
1 FEBRUARY 2013
VOL 339, ISSUE 6119
PAGE 515

BACKGROUND

There are growing concerns about the ubiquitous presence of pharmaceuticals in the environment[1], especially when coupled with knowledge of the dramatic impacts individual drugs and mixtures can have upon biota[2,3] - such as antibiotic resistance[4,5] and endocrine disruption[6].

As future pharmaceutical usage is predicted to rise, due to a number of reasons including the aging demographic, availability of generics and global epidemics, such as obesity and bird-flu[7], it is essential that we begin to take steps towards limiting environmental contamination.

This information graphic poster shows the complex system of pharmaceutical transport around the areas in which we live (adapted from Petrović et al[8]). It also shows influence routes, suggesting possible points of intervention to begin to address the problems associated with environmental pharmaceutical pollution.

KEY

INFLUENCE

PHARMACEUTICAL TRANSPORT INTO ENVIRONMENT

ROUTES BACK TO PEOPLE

PROMOTIONAL INFLUENCES

The pharmaceutical industry spends billions of dollars annually promoting its products[9]. This plays an important role in raising medical professionals' awareness and potentially improving clinical outcomes. However, the pathways of promotional influences are not always recognised. Direct-to-consumer advertising and promotional gifts to physicians, neither of which should influence clinical decision making, have been shown to influence prescription rates and thus, indirectly, the amount of chemicals entering the environment[10].

REFERENCE LITERATURE

There are many different sources that health professionals use for reference when prescribing, including national formularies, published guidance, mobile phone apps, and others. However, the published scientific evidence on which such resources are based are sometimes funded by the pharmaceutical industry[11]. Those who receive such funding are more likely to report favorable results in the academic press than independent researchers[12,13].

TRAINING AND EDUCATION

Education can be an important way of encouraging responsible and effective prescibing practice. Health professionals' attitudes towards the pharmaceutical industry and their products are formed during training[14]. Restricting contact with pharmaceutical industry representatives during this time can attenuate positive attitudes towards the industry[15] and may subsequently reduce promotional influence on prescription rates[16].

AIR POLLUTION

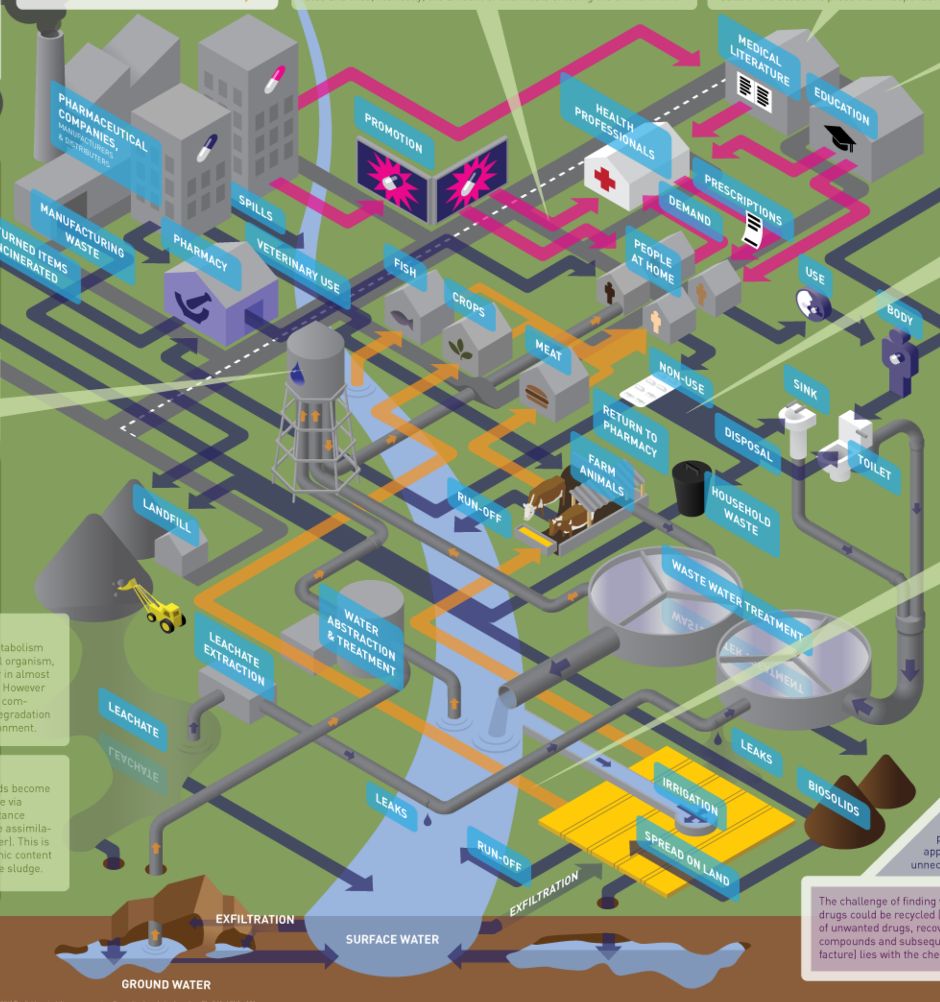
The quantities of waste that can be incinerated are limited by the amount of air pollution that is considered safe - and depends on other sources of air pollution in the area.

FATE 2 – INCINERATION

High temperature incineration (above 1200°C) is viewed as the safest disposal route for unwanted pharmaceuticals (particularly those with high halogen content).
Unfortunately, high temperature incineration is expensive and in some situations only medium temperature incinerators (above 850°C) are available.

FATE 1 – METABOLISM

When drugs are consumed, a proportion of the drug interacts or binds with a receptor in the body, which causes a biological response. The body transforms the remaining compound into a more water soluble form, allowing it to be excreted. Pharmaceuticals can be excreted as parent compounds (the drug consumed) or metabolites, in urine or faeces. In some cases an excreted metabolite can be as bioactive as the parent compound, such as Norfluoxetine, the metabolite of Fluoxetine HCl (Prozac®).



NON-USE

Many individuals do not take all, or even any, of their prescribed medication. Reasons include forgetting, reluctance, thinking them no longer necessary, side-effects and being 'out of date'[17,18]. Forgetting can be tackled using simple psychological techniques[19]. In the UK it is estimated that 63% of unused medication is disposed of via household waste, 12% via the sink or toilet and only 22% are returned to pharmacies for safe disposal[20]. Similarly low rates of safe disposal are reported in the US[21].

DRINKING WATER

Water treatment processes vary across the world; with water for processing sourced from groundwater, surface water or from waste water treatment plants. As pharmaceuticals are present in all these compartments, the presence of drugs in our drinking water is of little surprise[22,23].

FATE 4 – DOWNSTREAM

Once pharmaceuticals have entered the environment they can continue to be transported via our waterways to other towns and eventually the sea. Some pharmaceuticals have even been found as far away as the arctic!

FATE 3 – LOSSES

Degradation is the term used to describe the breakdown of a chemical into smaller component compounds or elements. Usually only partial degradation occurs (where specific chemical sub-structures are lost). Total degradation of a pharmaceutical to its elements, also termed complete mineralisation, is uncommon.

PHOTODEGRADATION

is a form of abiotic degradation, which can be important for the breakdown of pharmaceuticals, particularly in surface waters and during some waste water treatment processes. Absorption of radiant energy (photons), such as those in sunlight, by a compound results in photochemical transformation of the compound into smaller fragments.

BIODEGRADATION

or biotic degradation, involves metabolism of pharmaceuticals by a biological organism, such as bacteria - and does occur in almost all parts of this transport system. However many pharmaceuticals are stable compounds, that are resistant to biodegradation and therefore persist in the environment.

BIOACCUMULATION

of pharmaceuticals can occur in organisms in the environment. Where a drug has a higher affinity for the chemical properties of particular tissues (e.g. fat) than it does the surrounding environment, it can become concentrated in an organism.

SORPTION

is the process by which compounds become associated with another substance via absorption (permeation of a substance by another) or adsorption (surface assimilation of one substance upon another). This is a process often seen in high organic content materials such as soil and sewage sludge.

BIOAVAILABILITY?

We have an understanding of pharmaceutical transport around our environment, from our homes to waterways, aquatic organisms, fields and therefore potentially crops and/or animals. However, we lack knowledge about whether these compounds could be transferred to the consumer and if they have the same effect as taking medication.

ROUTES TO SUSTAINABILITY

This graphic illustrates the complex movement of pharmaceuticals around our social and physical environments, cycling endlessly.

Legislative pyramids[24] provide a hierarchy of management strategies for waste reduction (reducing in sustainability down the pyramid). This concept could be used to limit environmental contamination by pharmaceuticals.

REDUCE – Upstream interventions should be the highest priority. Green pharmacy, which seeks to develop specific targeted drugs and/or more effective delivery mechanisms, has the potential to reduce the dosages required[25]. Also, education of consumers and prescribers could result in more appropriate disposal and reduce unnecessary prescribing.

REUSE – Widespread acceptance of medical donation programmes[26,27] would result in greater reuse of drugs and could be facilitated by use of smaller packaging.

RECYCLE – The challenge of finding ways in which drugs could be recycled (processing of unwanted drugs, recovery of 'usable' compounds and subsequent product manufacture) lies with the chemical industry.

RECLAIM – Reclamation of pharmaceuticals (most likely at the waste water treatment works), followed by purification and reuse of drugs expensive to produce, could in theory be implemented alongside removal programmes.

REMOVE – Removal programmes could incorporate capture and destroy approaches (e.g. granular activated carbon[28]), chemical transformation processes (e.g. ozone processing[29]), or could seek to maximise natural degradation processes by optimisation of treatment e.g. identifying, isolating and seeding with drug-degrading bacterial strains.

REFERENCES

1 Kallenborn, R. et al. in Pharmaceuticals in the Environment: Sources, Fate, Effects and Risks (ed K. Kummerer) 61–74 (Springer, 2008)

24 Mark J. Benotti et al. Pharmaceuticals and Endocrine Disrupting Compounds in U.S. Drinking Water Environ. Sci. Technol., 2009, 43 (3), pp 597–603

25 Kümmerer, K. and Hempel, M (Eds) 2010 Green and Sustainable Pharmacy Springer, pp 313

Vatten och läkemedel

Akademiska Sjukhuset Uppsala

IKEM – Innovations- och kemiindustrierna i Sverige

Aktiviteter ur livscykelperspektiv

Procurement
3.1.2 Upphandling som styrmedel

Prescription
3.1.2 Upphandling som styrmedel
3.1.4 Konsumentbeteende

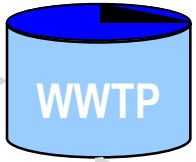
Sales
3.1.2 Upphandling som styrmedel
3.1.4 Konsumentbeteende

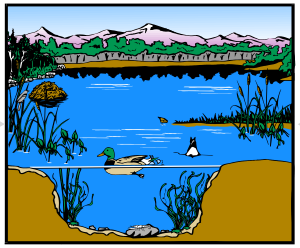
Use
3.1.4 Konsument beteende

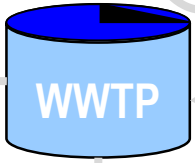
WWTP
3.1.3 Effluent management
3.1.5 Reningsteknik

Recipient
3.1.1. Miljöövervakning/mätning

Manufacturing/supply
3.1.2 Upphandling som Styrmedel
3.1.3 Effluent management
3.1.5 Reningsteknik







WWTP
3.1.5 Reningsteknik

Waste
3.1.4 Konsumentbeteende

Raw Materials /API
3.1.2 Upphandling som styrmedel
3.1.3 Effluent management
3.1.5 Reningsteknik

Recycling

SIWI SWEDISH WATER HOUSE
swedishwaterhouse.se