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Drugs on tap

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Taking a pill for a headache may seem like the most natural thing in the world, but prescription drugs are forcing their way into every corner of our lives and environment, says John Naish

Big marketing budgets pay dividends when one drug in four sold by pharmacists is a painkiller

This article was updated on 16th October 2009, following a notification of an inaccuracy.

Britain has a serious and unnecessary drug habit, but the implications of our pill-for-every-ill culture go far beyond the adverse effects on human health. The complex chemicals in modern pharmaceuticals, as well as the manufacturing processes involved, leave a massive industrial footprint on the natural world that is largely ignored by both science and government.

While pharmaceuticals may often be lifesavers, they are also the product of a massive global industry that manufactures compounds that can interfere, in myriad and unintended ways, with complex biological functions. They are often designed to break down slowly and have yet-unknown consequences to the environment. As a new Government report points out, they also contribute significantly to global warming: NHS drug-purchasing alone is responsible for millions of tonnes of carbon dioxide emissions a year.

We are an overmedicated with older people and children receiving the vast majority of needless drug prescriptions, according to a 2003 report in the *Journal of Social and Administrative Pharmacy*. Our over-the-counter drug use is spiralling: UK sales of the painkiller Anadin in 2007 totalled nearly 27 million packs. As its maker, Wyeth Healthcare, boasts: 'If stacked on top of each other, they would reach over 56 times the height of Mount Everest'.

Our ever-growing consumption is encouraged by a powerful triumvirate: Big Pharma with its demanding shareholders; doctors who fire off quick fixes from their prescription pads and health journalists hungry for the next 'medical breakthrough' story. Having worked in health journalism for 20 years, I have frequently witnessed how lazy writers and headline-hungry editors ignore clear evidence of thin or dodgy science when publicising drug cures for everything from shyness to brain tumours.

The ecological cost is publicly invisible, but all the bioactive chemicals we ingest ultimately enter the water system, either through lavatories or refuse disposal. Thus they contaminate the food chain and our drinking water. The cumulative result is... Well, we don't know, because nobody is trying too hard to find out. Despite official indifference, however, a picture is starting to emerge. And it looks worrying.

Pills in the developing world

There is a serious ethical dimension to the ecological problem, too. We are exporting many of the worst effects of our desire for cheap pills to the developing world, in particular to India and China, where so many of these medicines are now made.

Joakim Larsson, an associate professor at Gothenburg University, Sweden, has, over a number of years, tested river water at the pharmaceutical industry zone of Patancheru, near Hyderabad, central India. His recent report, published in the journal *Nature* in February 2009, revealed the presence of unprecedented levels of drugs.

Larsson's team found that the plant discharges an estimated 45kg of the antibiotic ciprofloxacin in one day, equivalent to five times the daily consumption of Sweden. Water from 90 Indian pharmaceutical factories goes through a water-treatment plant before discharge into the river, but Larsson's data showed that the supposedly cleaned water was a soup of 21 different active pharmaceutical ingredients, used in generic (i.e. non-branded) drugs for the treatment of hypertension, heart disease, chronic liver ailments, depression, gonorrhoea, ulcers and other ailments. Half of the drugs measured at the highest levels ever detected in the environment.

India has become one of the world's leading pharmaceutical exporters, with most of its products going to the US and Europe. Half of the 242 generics on the Swedish market examined by Larsson's team contained substances from India. We can't tell what precise proportion of Indian pharmaceuticals are used in British generic drugs, because the UK Government does not monitor this. According to a spokesman for the Department of Health: 'The sourcing of generic medicines from outside the UK is a matter for individual licensed importers'.

Larsson's study found that ciprofloxacin and the popular antihistamine cetirizine were found in the highest levels in the wells of six nearby villages where local residents have no choice but to drink the contaminated water. Such concentrations of riverborne antibiotics effectively provide a training school where bacteria can learn how to fight them - presenting the risk of new drug-resistant bacteria strains becoming pandemic.

Rajeshwar Tiwari, who heads the Patancheru area's pollution control board, says regulations have tightened since Larsson's initial research in 2005, but adds that screening for pharmaceutical residue at the end of the treatment process is not required.

China also has evident problems: a 2007 study by Chinese scientists in the journal *Environmental Monitoring and Assessment* found that riverborne emissions from one Chinese contraceptive-manufacturing plant contained 10 times the amount of oestrogen required to make a fish population collapse.

Absorbing issues

In Europe and the US, the primary pollution problem stems not from factories but from the fact that medicines are excreted without being fully metabolised by people who take them. How much passes through the body depends on the medicine. Data collected by the chemist James Shine at the Harvard School of Public Health shows that the body metabolises more than 80 per cent of the pain-reliever acetaminophen and the antidepressant fluoxetine, yet absorbs only 20 per cent of other drugs, such as metformin for diabetes and atenolol for high blood-pressure. The rest goes down the loo. Add to this the intensive use of antibiotics in agriculture: 446 tonnes of active ingredient were used by UK farmers in 2005, according to the Soil Association; in the UK, more than 90 per cent of veterinary antibiotics are used in pig or poultry production. Much of this use is 'preventative', or 'just in case', rather than curative.

Wastewater in Britain is treated to remove contaminants, a process sporadically tested by contractors and academics, says the UK Drinking Water Inspectorate. The purifying systems are not specifically designed to remove drug residues, however, and a report commissioned by the inspectorate says that reported removal rates for pharmaceuticals vary considerably between studies. Sophisticated European treatment systems may even backfire, it cautions: 'Concentrations of some compounds have been found to increase during the treatment process, probably as a consequence of the transformation of conjugates back to the parent compound'.

Doctors are currently most concerned about the effect of waterborne 'cytotoxic' - cell-killing - cancer drugs currently taken by 250,000 Britons. These drugs are flushed from the body and into sewers largely unaltered, remaining highly toxic. They are hard to destroy in water-treatment plants. Dr Andrew Johnson, a water quality scientist at the Centre for Ecology and Hydrology at Wallingford, Oxfordshire, has led two studies on pollution risk in rivers, including one on the Thames, and concluded that there may be sufficient chemotherapy drugs to contaminate tap water. 'There is at least the theoretical risk of low-level contamination by cytotoxic drugs,' he says. 'It is highly unlikely that concentrations below the nanograms per litre level would represent a risk to adults. But human fetuses and new babies could be particularly vulnerable to minute amounts of these agents, which are designed to prevent cell division.'

In an ongoing study, Britain's Drinking Water Inspectorate is running pilot tests of potential high-risk rivers at the point where human drinking water is extracted, to ascertain if there is any danger of pharmaceutical pollution. The trials test for three unnamed pharmaceuticals and at least one illegal drug, such as cocaine or heroin, but the test results will not be available until next year.

...and Prozac for all

Back in 2004, the Environment Agency first cautioned that Prozac was detectable in British drinking water, though the levels were thought to be at 'very low concentrations'. Subsequently, the Agency asked manufacturers in May 2005 to monitor the water levels of Viagra and Prozac, worried that they could be harmful.

Fluoxetine hydrochloride was first introduced in 1988 by Eli Lilly and Company, and marketed under the trade name Prozac. Since the patent expired in 2000, the compound has been marketed in the UK by a number of other companies. In 2004, UK doctors issued more than five million prescriptions for fluoxetine - equating to around 4.1 tonnes of the compound. Research suggests that once fluoxetine is in the environment it is not easily broken down.

In the US, meanwhile, a five-month investigation by the Associated Press in 2008 found that the drinking water in many major cities contains a variety of prescription medicines in low concentrations. The drugs include sex hormones, antibiotics, mood stabilisers and anticonvulsants.

The British water industry's scientific collaborative body, UK Water Industry Research, is currently investigating how it can cost-effectively remove oestrogens from sewage, via two pilot projects run by Thames Water and Severn Trent Water. It says it believes there is an 'acceptably safe' level of oestrogen in river water that will not harm wildlife.

The pharmaceutical industry says it supports monitoring of environmental residue levels and likewise believes that they are safely well below any level that could harm human health. But how would it know? Ecotoxicity data is available for less than one per cent of human pharmaceuticals, according to estimates published in the journal *Regulatory Toxicology and Pharmacology* in April 2004. Nor do we know what the drug compounds do when they break down in the environment, during water treatment and inside our bodies.

Some scientists fear that they may become more toxic. We simply do not know what happens when lots of these chemicals combine; they may, for example, make new compounds whose toxicity is powerful but unknown. There are also significant concerns about the effects on humans of long-term exposure to multiple drug contaminants at low levels. Dr Johnson says: 'There is a need for a lot more research. However it is not currently fashionable. The public are concerned, but the research-funding agencies much less so. We don't have enough information to rule out whether it is an issue. The concentrations of chemotherapy drugs involved are the same as the levels of oestrogens that we know can cause problems in fish.'

In wildlife, the most documented problem is the feminisation of male fish living downstream of wastewater treatment plants. A February 2008 study in *Chemical & Engineering News* by Karen Kidd, a biology professor at the Canadian Rivers Institute, says: 'It doesn't take a lot of oestrogen to feminise male fish. If you can measure the oestrogen in the water, then that's enough to cause an effect, and we can measure it at very low parts per trillion'.

Furthermore, fish exposed to an antidepressant drug, venlafaxine (marketed as Effexor) startle less quickly and become easy prey, according to a study reported by Meghan McGee of Minnesota's St Cloud State University to the 2008 North America annual meeting of the Society of Environmental Toxicology and Chemistry. Similar research shows that antidepressants can impair a fish's ability to eat, to avoid being eaten - and perhaps to attract a mate.

Carbon pharmacopoeia

On top of the biological problem comes the carbon problem. The NHS carbon-reduction strategy for England, titled *Saving Carbon, Improving Health*, was published in January and reveals that the largest part - 60 per cent of the NHS carbon footprint is from procurement. Pharmaceuticals represent by far the largest proportion of procurement - a full four million tonnes of CO₂ a year, equivalent to an extra three quarters of a million cars on the road. Commenting on the report in a *British Medical Journal* editorial in January 2008, Ian Roberts, professor of epidemiology and public health at the London School of Hygiene & Tropical Medicine, warns: 'The Government's emissions-reduction strategy is weak in this area, saying that "research will be undertaken into the carbon footprint of pharmaceuticals within the NHS to better understand this and to inform actions to produce significant reductions." This sounds like a dodge.'

He adds: 'The NHS could reduce drug-related carbon emissions either by reducing the carbon intensity of drug production or by reducing drug use. Because the global atmosphere also bears some of the costs, the real cost of drugs is even higher than the monetary cost. The NHS can and should use its purchasing power to press the drug industry to decarbonise.'

Professor Roberts sees drug-carbon reduction as a public health-promotion issue, too. He predicts that if the Department of Health does not strengthen its strategies for encouraging healthy eating, walking and cycling, Britain will have a predominantly obese society by 2050: 'If we want to avoid a situation where more than half of the population is taking carbon-intensive drugs to suppress their appetite or to prevent their bodies from absorbing fat, then we will need to do much better.'

A spokesman for drug-manufacturers' body the Association of British Pharmaceutical Industries says that its members are already committed to reducing their environmental impact: 'For instance, GSK [GlaxoSmithKline] has committed to reduce its energy use and global warming potential by at least 45 per cent by the end of 2015 on a per unit sales basis, and Eli Lilly has set a global 15 per cent energy efficiency improvement target by 2013.'

Measures are under way to reduce the carbon footprint of pharmaceutical production. For example, engineers at the UK research-and-development organisation, C-Tech Innovation, launched a prototype in March of a new microwave technology that speeds the chemical reactions necessary to produce active ingredients in drugs. But this type of efficiency may prove double-edged. Lower energy use is a business advantage that may enable drug-making multinationals to produce more pills that will inevitably end up in the environment.

As individuals, we bear a significant personal responsibility for reducing drug-related pollution. As well as cutting the environmental levels of antibiotics by eating less intensively reared meat, we could also ensure that we pop far fewer pills. As any hard-pressed GP knows, prescribing tablets is a great way to get recalcitrant patients out of their surgeries. Studies show that half the antibiotics prescribed by GP surgeries are unnecessary. Likewise more than 30 per cent of pills work because of a placebo effect: the actual chemicals do nothing, it's just we believe so strongly in a 'pill for every ill' that we think we can't get better without them.

The UK's over-the-counter (OTC) remedy market is huge and continues to grow: income from painkillers alone jumped by nearly a quarter between 2001 and 2006, to approximately £900 million, according to drug industry body the Proprietary Association of Great Britain. Big marketing budgets pay big dividends in a world where one drug in four sold by pharmacists is a painkiller. The patents are long expired for the three basic analgesics available OTC in Britain - aspirin, paracetamol and ibuprofen - so they can be made and sold very cheaply.

Big Pharma is constantly inventing ingenious ways to sell the same substances. Nowadays, painkillers are marketed as lifestyle accessories. Solpadeine, for example, promises to 'make you feel human again', while Anadin's Ultra Double Strength pills launched with a £4 million campaign as the pill, 'For people who just get on with it'. Seductive packaging is crucial, too: when Nurofen launched its special 'mobile' pack (the 20th different Nurofen niche sub-brand), creators Design Cognition said it 'reinforced

Nurofen as an innovative, aspirational and world-leading brand'. Aspirational? Four months after landing on UK shelves in 2002, it had boosted Nurofen's market share from 23 per cent to 28 per cent.

The incurable headache

Continually pushing the stressy-ill market has a perverse but lucrative result: swallowing more OTC painkillers makes people increasingly prone to 'rebound headaches' - headaches caused by withdrawal symptoms from OTC painkillers. This encourages habitual pill-poppers to take more painkillers, and the costly cycle continues.

This cycle offers a stark metaphor for so much of our pharmaceutical use, where drug-science is frequently offered by our culture as a panacea for problems that our culture creates. This is perhaps most clearly exemplified by depression, a condition often induced or exacerbated by chronic stress, and which the World Health Organization says is about to become the second-biggest health problem in the developed world (other fast-growing illnesses such as cancer and hypertension are also viewed as significantly stress-related).

The most effective remedy for depression, as recommended by the Government's own watchdog NICE (National Institute for Health and Clinical Excellence), involves comparatively expensive and time-consuming talking interventions, such as cognitive behavioural therapy. Lifestyle changes, such as bolstering one's relationships with friends and family, and developing one's own spiritual side, are also known to help significantly.

As NICE itself admits, however, our GPs are also part of the rush-rush culture, with only a few minutes per patient consultation, and limited budgets - so quick-fix antidepressant drugs remain the frontline therapy. Their use has spiralled over the past decade. Prescriptions for British children under the age of 16 alone rose from 48,264 in 1997 to 454,797 in 2007.

Such virulent antidepressant use carries serious environmental as well as social dangers. A Swedish study reported in *The Pharmaceutical Journal* in March 2009 listed seven drugs considered ecologically perilous, because they degrade slowly and are liable to bioaccumulate. Three of the drugs were antidepressants: Citalopram, Mirtazapine and Escitalopram.

As consumers, we must strive to resist the siren call of the chemist shop, which thrives by offering convenient pills and potions to soothe away the headaches and stomach pains produced by high-stress, high-impact, accelerated lifestyles. Ultimately, cutting our pharmaceutical dependence will depend on the developed world adopting a considerably more holistic approach to health: we need to examine and tackle the root cultural causes of environmentally induced mental and physical illnesses. Piling more drugs into the equation certainly won't help the long-term problem. They will only give us a much bigger headache - in the shape of a therapeutically poisoned ecosystem, as well as a chronically overstressed culture.

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So should you still drink tap water?

The Government doesn't require drug testing of tap water or bottled water (often simply filtered tap water) and current purification processes don't get rid of all drug residues. There are no at-home filters that are certified to remove all drugs. A reverse osmosis (RO) filtration system will remove most pharmaceuticals from water, but can be wasteful, flushing three to 20 litres of 'waste' water down the drain for every litre of treated water (though some newer models claim to be virtually wastefree). In a world running out of water this is not a sustainable option.

So should you drink tap water? The short answer is yes, because what other option do you have, and because of the ethical, moral and environmental impacts of bottled water. But also become more aware of your own drug habits. Most OTC drugs are taken for self-limiting (i.e. they get better by themselves) conditions. Be more vocal about the issue of water pollution. Write to drugs companies about their waste and their irresponsible encouragement of drug use. Write to your MP and let Government know that it is unacceptable continuously to shift responsibility to the consumer to try to deal with waste that is created by major multinationals and then ignored by official agencies.

