

## Perspective

# PHARMACEUTICAL WASTE IN THE ENVIRONMENT: A CULTURAL PERSPECTIVE

Felicity Thomas

Centre for Medical History, University of Exeter, UK

Corresponding author: Felicity Thomas (email: f.thomas@exeter.ac.uk)

## ABSTRACT

**Introduction:** There has been a significant rise in the use of medical pharmaceuticals to combat disease and ill-health across the WHO European Region. However, global estimates suggest that over half of all medicines are prescribed, dispensed or sold inappropriately, and that half of all patients fail to take them as directed. As well as impacting negatively on individual health, and resulting in extensive resource waste, pharmaceutical use – and “misuse” – can have significant adverse repercussions on wildlife and ecosystems,

particularly when unused medicines are disposed of inappropriately.

**Methods:** This paper examines the rise in medicine (mis)use, and considers what is known about pharmaceutical waste in the environment. While technological responses to alleviate the impacts of pharmaceutical waste exist, they are costly and complex, and do not address the root causes of the problem.

**Results:** This paper demonstrates how incorporating a cultural perspective can help

us to understand not just *how* medicines can be more thoughtfully disposed of, but *why* particular medicines are administered to, and consumed or disposed of by, particular population groups in the first place.

**Conclusion:** Understanding the ways that people’s perceptions, beliefs, and social norms and values interrelate with medicine prescribing, consumption and disposal practice is key to alleviating medicine misuse.

**Keywords:** PHARMACEUTICAL WASTE, ENVIRONMENT, MEDICINE, CULTURE

## INTRODUCTION

Countries across the WHO European Region have witnessed a significant rise in the use of pharmaceuticals to combat disease and ill-health. However, global estimates suggest that over half of all medicines are prescribed, dispensed or sold inappropriately, and that half of all patients fail to take them as directed (1,2). As well as impacting negatively on individual health, and resulting in costly resource waste, it is increasingly recognized that this rise in pharmaceutical use – and “misuse” – can have significant adverse repercussions on wildlife and ecosystems, particularly when unused medicines are disposed of inappropriately (3,4).

In line with Sustainable Development Goal 12 to “ensure sustainable consumption and production

patterns”(5), it is important that policy-makers across the European Region understand the array of factors that drive these high levels of pharmaceutical use and misuse. Countering the problems associated with disposal of potentially harmful pharmaceutical waste therefore requires not only reactive technological responses, but also cultural insights that help to shed light on the rise in medicine use, as well as on medical prescribing, consumption and disposal practices.

## MEDICINE USE AND MISUSE

An ageing demographic, the rise of chronic health conditions, the availability of inexpensive generic treatments, and the advent of “lifestyle” drugs have been the key drivers of increased pharmaceutical medicine use within the European Region. The need for many of

the most commonly used long-term medications has come about – at least in part – because of the complex relationship that exists between changes to human lifestyles and the changing natural environment. Increasing use of statins and diabetes medicines, for example, can be linked to increasingly sedentary lifestyles promulgated by urbanization, while sufferers of respiratory diseases may experience exacerbated symptoms through factors such as air pollution.

Particular types of medicines have seen especially large increases in use in recent years, reflecting wider demographic and lifestyle changes. Medicine use for preventive purposes is also now commonplace in some countries, with biomarkers used to assess risks often resulting in medicine use, even when health risks are relatively low (6,7). In England, for example, prescriptions for just one type of statin used to reduce cholesterol rose from 12.8 million items to 18.2 million items over one year alone (8). Similarly, data show that the use of antidepressants across 29 countries in the European Region increased on average by almost 20% per year from 1995 to 2010 (9). Large increases in the dispensing of antibiotics, antiepileptics, antidepressants, drugs for treating diabetes and some analgesics have also been reported across many parts of the Region (10,11).

## MEDICATING THE ENVIRONMENT

While the health and economic benefits of pharmaceutical advances are widely recognized, pharmaceutical waste is increasingly impacting on the natural world, as unused medicines are disposed of or discarded inappropriately (3,4). Pharmaceuticals have been found mainly in surface waters such as lakes and rivers, but also in groundwater, soil, manure and even drinking water. There are two main routes by which active pharmaceutical ingredients used within human medicines enter the environment. First, when medicines taken are excreted in urine or faeces; and second, when unused medicines are thrown down the toilet or sink. In both cases, medical pharmaceuticals end up in sewage treatment plants that are generally not designed to remove such pollutants from wastewater.

At the turn of the twenty-first century, the European Environment Agency (EEA) identified concerns over the environmental impact of pharmaceutically

active substances as an important emerging issue (4). A recent global review reported that of the 713 pharmaceuticals tested for in the environment, 631 were found above their detection limits (12). Research undertaken in Germany found that up to 16 000 tons of pharmaceuticals were disposed of annually from human medical care, with 60–80% of these drugs flushed down the toilet or placed in normal household waste (13). As well as environmental costs, such actions have significant adverse economic impacts. In the UK, for example, the estimated costs of dealing with medicine waste to the country's National Health Service range from £100 million to £300 million a year (14, 15).

Although clear links between cause and effect are disputed and often hard to discern, there is general consensus that compounds from medical waste can have damaging impacts on invertebrates, vertebrates, and ecosystem structure and function. It is also accepted that a range of factors makes it difficult to fully assess their impact. For example, it is possible that small and microorganisms are experiencing many of the less obvious impacts of pharmaceutical waste, yet these may go unnoticed unless researchers are specifically looking for them. It is also possible that monitoring and assessment of individual substances may be misleading, and may underplay the aggregate toxicity of substances that are mixed within many pharmaceuticals (4).

Thus, while debate remains on the precise impact of pharmaceuticals in the environment, there is wide-scale consensus across Member States of the WHO European Region that more needs to be done to reduce environmental risk factors and to ensure the rational use of medicines. Importantly, with an estimated 25 000 people dying each year in Europe from antibiotic-resistant bacteria (16), it is also vital to recognize that strategies to reduce the introduction of antibiotics into the environment can help to contain antimicrobial resistance.

## CURRENT RESPONSES TO PHARMACEUTICAL WASTE

Given the undoubted benefits that pharmaceuticals bestow within modern medicine, it is important that strategies to mitigate their environmental

impact be directed to prevent, reduce and manage them without compromising their effectiveness, availability or affordability. A number of responses to dealing with pharmaceutical waste have therefore been proposed within the European Region. “Green pharmacy”, for example, recognizes the potential for designing new drugs that are less harmful for the environment (17). Improved sewage treatment to reduce the amount of pharmaceutical residue reaching ground and surface waters is also put forward as a possible strategy (4).

Yet such reactive approaches are complex and extremely costly, and will in themselves do little to mitigate either the underlying causes, or the likely further increase in medicine misuse yet to come.

A more preventive approach has been applied in Sweden, where Stockholm County Council grades medicines on their environmental effects, and doctors are able to prescribe a less harmful drug where the option exists (18). Public education to reorient social norms and expectations towards more responsible medicine use is also widely seen as a fundamental necessity (19,20), and in some countries in the European Region, there is evidence to support the effectiveness of this approach. Educational initiatives such as the e-Bug programme, for example, have been made available to many school students across the European Region, and have reportedly been well received in countries such as France (21).

In general, however, “one-size fits all” public education programmes have been found to have relatively little impact on medicine consumption and disposal practices. This is likely a result of the fact that they do not tend to take into account the cultural and social factors that influence health, nor consider how local beliefs and perceptions may act as barriers to behaviour change. As WHO (22) has stated, “People often have very rational reasons for using medicines irrationally,” and it is important that such reasons are understood in greater depth if responses to medicine misuse are to effectively tackle the root causes of the issue. This involves asking not just *how* medicines can be more thoughtfully disposed of, but also asking *why* particular medicines are administered to, and consumed or disposed of by, particular population groups in the first place.

## INCORPORATING A CULTURAL PERSPECTIVE

Incorporating a cultural perspective to understand medicine misuse can provide insights into the ways that people’s perceptions, beliefs, and social norms and values interrelate with medicine prescribing, consumption and disposal practices, and how these are, in turn, intrinsically bound up with broader social, political and economic forces (23). Taking on board a cultural perspective can therefore help us to understand why geographical and social variations exist in rates of medicine prescribing across Europe, and can offer insights that help account for key issues such as discrepancies in the frequency of antibiotic-resistant infections across the Region (20,24).

Studies within the social sciences and medical humanities have demonstrated that pharmaceutical use is not always linked to medical necessity and that particular working practices inherent within some economic and health-care structures support incentives for prescribing, and may be key to securing income for health providers (25). Interlinked with this, variations in medicine use can be explained by diverse cultures of prescribing and working practice. Research on antidepressant prescribing in England, for example (26), found that general practitioners (GPs) under the age of 55 years who had qualified in the UK were more likely to submit to a culture of prescribing than those who were older, or who had qualified elsewhere. Other research has found that it is not only prescribing rates that differ, but that *types* of medications and treatments prescribed for particular conditions can vary across population groups. A study in Ireland (27) found that newer, more costly diabetes treatments were being prescribed to patients from higher socioeconomic groups, despite all patients receiving free prescriptions. Similar work in the UK (28) found that people from lower socioeconomic groups were more likely to be given antidepressant medications than people from higher income groups, and that a range of cultural norms and expectations relating to expressions of self-identity and well-being made it more difficult for them to access psychological “talking therapies” than those from wealthier backgrounds. Research from 27 countries across the European Region has also concluded that societal attitudes towards mental health impact on the uptake of and adherence to antidepressants, and help explain the

wide regional disparities (29). Although such findings do not in themselves demonstrate medicine misuse, they show clearly how prescribing cultures interact with subjectively defined needs and expectations, and with the logistic and systemic boundaries within which health professionals work.

Recognizing that discrepancies exist in prescribing practice therefore raises important questions about the perceptions and attitudes that different population groups hold towards various medical conditions, and what they deem to be appropriate and rational responses to them. This is exemplified in research that shows that people from diverse backgrounds may experience similar levels of difficulty or discomfort in very different ways (30). It illuminates the value of in-depth qualitative research that explores how people perceive their health and well-being within the broader context of their daily lives, the cultural value that they accord to particular types of medicines and treatments (31,32), and the ways that pharmaceuticals can be closely bound up with personal identity and social relations (33). Research within mental health suggests that where time and attention have been given to exploring such perceptions and circumstances, the prescribed treatment is more likely to be used as directed, and more likely to result in positive health outcomes (34). Yet, despite this evidence, and its clear implications for reducing unnecessary pharmaceutical waste, few health systems are adequately resourced to properly implement this more personalized and culturally sensitive approach.

Changes in public expectations and behaviours also play a role in the rising use, and misuse, of medicines. Research has demonstrated, for example, how socially and culturally defined norms can problematize certain forms of appearance or behaviour, which then get defined in medical terms, understood through the use of a medical framework, or treated with a medical intervention. The increasing availability of methylphenidate, for example, has been said to have accelerated the acceptance of attention-deficit hyperactivity disorder (ADHD) as a medicalized description of disruptive behaviour in children (35), while the same drug has recently been re-marketed to improve cognitive performance among healthy people (36).

Popular media, advertising and increased access to the Internet have also played a key role in embedding pharmaceutical use within everyday life and, in cases, recasting medicines as consumer goods (37). At the same time, public expectations can be influenced by health policy, which in some countries within Europe, now positions patients as “experts” active in their own health care and management. Evidence suggests that such changes can help people to more effectively demand medicines that they have heard about and consider their right to use, raise expectations in relation to health possibilities, and encourage people to see medicines as a way of coping with, and addressing their wider problems (38). While public expectations play a central role in the rise of medicine prescribing, understanding more fully what such fundamental changes towards a consumer-oriented culture mean in terms of the ways that diverse medicines are perceived and used – or discarded – by different population groups, would provide a strong foundation on which effective responses to medicine misuse could be built.

It is also worth considering how norms embedded at an institutional level may impact on the availability and (mis)use of pharmaceutical medicines. Critics of the pharmaceutical industry have, for example, highlighted how a “culture of optimism” is generated around the value of new drugs, which increases the demand for such treatments while simultaneously exaggerating their benefits (38). Cultural preferences around the reporting and monitoring of medicine (mis)use have also been reported. A recent study on pharmaceuticals in the environment found that the types of pharmaceutical residue that were monitored and reported on varied widely across different parts of the European Region. Thus, while health priorities were thought to be influential, so too were the cultural preferences and priorities of those charged with commissioning and collecting the data concerned (12).

It is also important to recognize the ways that working practices within policy-making itself may hinder positive steps forward in combating the adverse impacts of medicine misuse. Strategies for addressing environmental issues that result from health-care practices have often failed to deliver effective solutions because they involve the collaboration of two professions – health care



and environmental science – which often pursue disparate priorities and cultural working practices (39). Acknowledging that embedded working practices may at times be obstructive, as well as finding ways to foster communication and collaboration across sectors, is likely to open up space in which innovation can be nurtured and progress made.

## CONCLUSION

Pharmaceutical waste in the environment is thought to have significant implications for the structure and functioning of ecosystems. Given the ongoing rise in pharmaceutical use and misuse, it is likely that without significant intervention, this issue will be exacerbated further in the coming years.

Innovative technological responses to dealing with pharmaceutical waste exist, but are complex and costly, and do not address the underlying causes of high medicine (mis)use. Incorporating a cultural perspective, and examining this within the context of wider social, political and economic forces, can help us to understand not just *how* medicines can be more thoughtfully disposed of, but *why* particular medicines are administered to, and consumed or disposed of by, particular population groups in the first place – insights that are vital for informing responses that can effectively tackle the root causes of the issue. It is also important to recognize that many of the most commonly used long-term medications now consumed within the European Region have come about – at least in part – because of the complex relationship that exists between the changing natural environment and changes to human lifestyles. Such circumstances make it especially important that ongoing efforts are made to foster cultures of collaboration across health and environmental policy-making.

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