Management of Pharmaceutical Household Waste

Limiting Environmental Impacts of Unused or Expired Medicine

POLICY HIGHLIGHTS
Pharmaceutical household waste from medicines that expire or remain unused do not only offer zero therapeutic benefit, but can also contribute to environmental pollution when improperly disposed. In addition to environmental risks, unused or expired medicines constitute wasted healthcare resources and can present a public health risk of accidental or intentional misuse and poisoning. Preventing pharmaceutical household waste and ensuring the effective collection and environmentally sound treatment of unavoidable waste is thus an important policy objective.
Key messages

Household medicine can become waste for a variety of reasons. Non-adherence, early recovery, therapy changes or prescription and purchasing errors can all lead to medicine remaining unused or expiring in households. Estimates of the share of household medication becoming waste vary from 3% to as high as 50%. In France, it was estimated that households disposed of 17 600 tonnes of unused or expired medicine in 2018, equivalent to 260 g per capita.

Improper disposal of pharmaceutical household waste can contribute to pharmaceutical pollution. Medicines flushed via sinks and toilets enter sewage waters and, if not filtered out, leak into aquatic systems. Disposal of unused or expired medicines via solid household waste can also result in pharmaceutical residues entering the environment, if this waste is illegally dumped, or destined for landfills without proper leachate collection systems.

The implications of improper disposal are threefold. First, certain pharmaceuticals have been proven to cause adverse effects on ecosystems, including increased mortality in aquatic species and changes to physiology, behaviour or reproduction. The discharge of antibiotics can also lead to mutations in animals and the development of antimicrobial resistant bacteria. Second, there is a possible public health risk of accidental or intentional misuse and poisoning if unused medicines are extracted from public or private waste bins. Third, unused pharmaceuticals represent wasted healthcare resources and economic losses.

Various policy interventions can be taken across the lifecycle to address this issue:

• Prevention measures such as personalised and precision medicine, better dimensioning of packaging sizes, marketplaces for and redistribution of unused close-to-expiry date medicines can help avoid pharmaceutical waste.

• Collection and disposal of unavoidable household-level pharmaceutical waste needs to be customised to the national context. Where there is a risk that medicines disposed in mixed waste can leak into the environment or be misused, separate collection is recommended to reduce environmental and public health impacts. Extended producer responsibility (EPR) schemes have shown to be an effective approach to organise separate collection and environmentally sound treatment. Alternative approaches such as publicly financed take-back schemes can also be effective but do not implement the polluter pays principle.

• Communications and awareness campaigns are key to increase awareness of citizens about proper disposal routes and/or the existence of drug take-back schemes. In particular liquids, ointments and creams tend to be discarded improperly and should be a focus of information campaigns and behavioural nudges.
Sources and entry pathways of pharmaceuticals into the environment

● Pharmaceuticals are present in the environment as a consequence of pharmaceutical production and formulation, patient use, use in food production and improper disposal. Households, hospitals, pharmaceutical production facilities and veterinary pharmaceuticals all represent sources of pharmaceuticals in the environment. While the contribution of each emission source varies, it is generally accepted that, globally, the main route for human pharmaceuticals to the aquatic environment is via discharge of untreated or treated wastewater from households.

● While excreted pharmaceuticals after consumption make up the largest source of household emissions, improper disposal of unused or expired medicine can be significant. Disposal via bathroom sinks and toilets contaminate wastewater streams and disposal via solid waste can lead to leaching of medicine residues over time, if solid waste is disposed of in landfills and leachate is not captured and treated appropriately.

● Estimates of the share of medication becoming waste vary from 3% to as high as 50% (Finnish Pharmacy Association, 2016; Law et al., 2015; Bound and Voulvoulis, 2005). In France, it was estimated that households disposed of 17 600 tonnes of unused or expired medicines in 2018, approximately 260 g per capita (Cyclamed, 2019). Another study measured a concentration of 8.1 mg Active Pharmaceutical Ingredients (APIs) per kg of municipal solid waste in Orange County, Florida, which they considered the lower bound of possible pharmaceutical contamination in municipal solid waste (Musson and Townsend, 2009).

In France, households disposed of an estimated 17 600 tonnes of unused or expired medicines in 2018, approximately 260 g per capita. (Cyclamed, 2019)
Figure 1. Main sources and pathways of human pharmaceutical residues to the environment

Source: OECD (2019).
Key entry pathways into freshwater and terrestrial ecosystems are through wastewater and landflling

**Wastewater treatment plants (WWTP)**
Conventional WWTPs are not designed to remove pharmaceuticals, resulting in emissions into waterbodies in unchanged or metabolised form. Depending on the removal efficiency of the conventional WWTP, some pharmaceutical residues are removed to a limited extent and collected in the sewage sludge. These may still enter environmental systems, when sewage sludge is applied on land for agricultural use (“landspreading”) or composting, both common practices in most OECD countries.

**Landfilled municipal solid waste**
Pharmaceuticals disposed of in municipal solid waste can also enter the environment. When mixed municipal solid waste is landfilled, pharmaceutical residues risk leaching into the environment if leachate is not collected and treated properly. Proper management of landfill leachate is critical to avoid dispersion of pharmaceutical residues.

Pharmaceuticals in the environment can have negative impacts on ecosystems and human health
The leakage of pharmaceuticals into freshwater and terrestrial ecosystems leads to their bioaccumulation and potential negative impacts on eco-system health. Certain pharmaceuticals have been proven to cause adverse effects, including increased mortality in aquatic species and changes to physiology, behaviour or reproduction. The discharge of antibiotics can also lead to mutations in animals and the development of antimicrobial resistant bacteria.

Humans can subsequently be exposed through drinking water, and ingestion of pharmaceutical residues in plant crops, fish, dairy products and meat. Exposure to certain pharmaceuticals, such as endocrine disrupting chemicals can trigger diseases related to reproductive and endocrine systems (e.g. breast or prostate cancer, infertility, diabetes, early puberty), immune and autoimmune, cardiopulmonary (e.g. asthma or heart disease) and nervous systems (e.g. Alzheimer’s disease, Parkinson’s disease and attention deficit hyperactivity disorder) (OECD, 2019). Sensitive populations, such as children, pregnant women, foetuses, and people with allergies and chronic diseases may be especially at risk.

Read our OECD publication *Pharmaceutical Residues in Freshwater*, which provides a comprehensive analysis of sources, pathways and proven and potential environmental health effects of pharmaceuticals.

https://doi.org/10.1787/c936f42d-en
The volume of unused pharmaceuticals is increasing, requiring heightened policy attention

Demographic, epidemiological and lifestyle changes such as an ageing and growing population, the rise of chronic health conditions, the availability of inexpensive generic treatments and changes in clinical practice have led to an increased pharmaceutical prescription and usage in OECD countries. As a consequence, the amount of unused medicines that becomes waste is also increasing. There are various reasons why medicines become waste, including changes in therapy, non-adherence, more rapid recovery, prescription and purchasing errors or expiration of stockpiled drugs.

Household disposal practices and collection rates among OECD countries differ significantly

Household disposal practices vary among OECD countries, critical drivers being the availability of drug take-back systems and the public awareness of these systems.

Figure 2. Household disposal practices of unused or expired medicines in selected OECD countries

Disposal practices also differ depending on the type of medicine

Liquids tend to be more often discharged in sinks or toilets, whereas solid (e.g. tablets and capsules) and semi-solid pharmaceuticals (e.g. creams and ointments) tend to be more often disposed of in solid household waste. Medicines considered to be more harmful, such as antibiotics are more likely to be returned to a pharmacy than over-the-counter products (e.g. cough medicine).

In Germany, 32% of survey respondents mentioned they flush liquid medicine leftovers at least sometimes, whereas less than 10% of respondents would flush solid unused or expired medicines. (Götz and Keil, 2007)
A range of interventions can help to minimise the impacts of unused pharmaceuticals

Various measures can be taken along the lifecycle to reduce the amount and impact of unused or expired medicine.

Table 1. Measures for minimising impact of unused or expired pharmaceuticals

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td><strong>Waste prevention</strong></td>
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<td>Disease prevention</td>
<td>Emission prevention through disease prevention.</td>
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<tr>
<td>Personalised and precision medicine</td>
<td>Medicines that are better targeted to patients’ needs can result in fewer and more effective treatments.</td>
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<td>Dimensioning</td>
<td>Reducing packaging sizes (particularly for new drug treatments and starter packs) reduces risk of accumulation of unused or expired drugs in households.</td>
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<td>Marketplace for unused pharmaceuticals</td>
<td>A marketplace for unused close-to-expiry-date (unopened) medicines provides better matching of supply and demand.</td>
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<td><strong>Collection and safe final disposal of waste</strong></td>
<td></td>
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<tr>
<td>Collection in mixed municipal solid waste and controlled final disposal</td>
<td>Collection in mixed MSW and incineration in state-of-the-art incinerators.</td>
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<tr>
<td>Separate collection: Drug take-back schemes</td>
<td>Take-back schemes prevent uncontrolled and improper household disposal of unused or expired drugs.</td>
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<td>Extended producer responsibility schemes</td>
<td>Puts the responsibility of the collection and end-of-life treatment of pharmaceuticals on the producer.</td>
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<tr>
<td>Education campaigns</td>
<td>Education and information campaigns inform about optimal household disposal routes.</td>
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<td><strong>End-of-pipe treatment</strong></td>
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<tr>
<td>Upgrade wastewater treatment plants</td>
<td>Upgrade wastewater treatment plants to capture emissions of excreted and discarded drugs in sewage.</td>
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1. Avoidance of pharmaceutical waste

A study in the Netherlands estimated that approximately 40% of pharmaceutical waste through unused or expired medicine could be prevented (Bekker et al., 2018).

Prevention measures such as improved disease prevention, personalised and precision medicine or better dimensioning of packaging sizes can help avoid pharmaceutical waste.

Up to 40% of unused or expired medicines could be prevented.  
(Bekker et al., 2018)
Marketplaces and redistribution of unused close-to-expiry date medicine can also improve the matching of supply and demand and prevent wastage. Resale and re-dispensing of unused medicines is still a niche, due to concerns regarding counterfeits, quality assurance and consequent legal restraints, but a number of initiatives exist. Studies are also underway in the Netherlands to assess the feasibility of re-dispensing unused high-value drugs, such as anti-cancer medication.

2. Separate collection schemes and take-back systems for household pharmaceutical waste

Fully eliminating unused medicines is difficult and proper collection and disposal is thus indispensable. Proper collection and disposal routes of unavoidable pharmaceutical waste depend on the national context. Where there is a risk that medicines disposed of in mixed waste can leach into the environment or be misused, separate collection is effective in reducing environmental and public health impacts.

In OECD countries, a variety of different collection schemes, take-back systems and stewardship programs aim to recover and manage household pharmaceutical waste. These can be voluntary initiatives, government funded programmes, or implemented as part of an extended producer responsibility (EPR) scheme. All four countries with high collection ratios (i.e. France, Sweden, Portugal and Spain) have an EPR system in place with full and harmonised national coverage and with collection points at pharmacies.

What is Extended Producer Responsibility?

Extended producer responsibility (EPR) is an environmental policy approach in which a producer’s responsibility for a product is extended to the post-consumer stage of the product’s lifecycle. Read more about this policy approach in our OECD Publication on Extended Producer Responsibility.

https://doi.org/10.1787/9789264256385-en
3. Raising awareness and induce behaviour change

The limited awareness of consumers about proper disposal routes and drug take-back schemes weakens their impact in many countries. Information campaigns can increase the awareness and use-rate of take-back schemes and improve disposal practices.

Other approaches can also lead to increased awareness and behavioural change. For example: special instructions for disposal that appear on the outer packaging of medicinal products or in the information leaflet; nudges such as ‘challenges’ or ‘saving accounts’ to return medication to pharmacies; and product eco-labelling to inform consumer choices. Awareness and informative tools for health professionals can also help to strengthen environmental considerations in prescription practices and disseminate the risk of inappropriate disposal routes among the population.

In Latvia, 60% of respondents admitted to not being aware of how to dispose of unused or expired medicines properly.
(Finnish Environment Institute, 2020)
Table 2. Possible measures to increase awareness and induce behaviour change

<table>
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<tr>
<th>MEASURE</th>
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<th>EXAMPLE INITIATIVE</th>
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<tr>
<td>Information campaigns</td>
<td>Information campaigns can increase the awareness and use-rate of take-back schemes. They can be financed and managed by public authorities, the private sector, NGOs or be an accompanying requirement in the design of EPR schemes.</td>
<td>The Medsdisposal campaign, a joint initiative between European healthcare, industry and pharmacist associations, aims to provide information on how to dispose of unused or expired medicine appropriately in different EU countries.</td>
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<tr>
<td>Incentives for returning medication to pharmacies</td>
<td>Incentives for returning medications to collection points, such as refunds or other rewards to nudge consumers to adopt appropriate disposal practices.</td>
<td>In Sweden most pharmacy chains offer bonus credit points to consumers for returning unused or expired medicine to collection points in pharmacies.</td>
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<tr>
<td>Product information provision</td>
<td>Special instructions for disposal that appear on the outer packaging of medicinal products, in the patient information leaflet or on the medication label can lead to greater awareness and behaviour change of consumers.</td>
<td>In the EU, providing this information is mandatory, according to EU Directive 2004/27/EC.</td>
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<td>Product eco-labelling</td>
<td>Eco-labels on the environmental impact of different medicines and other product information systems can inform consumer choice, selection and awareness, and assist doctors in decision making when prescribing medication.</td>
<td>In the Stockholm region in Sweden, a “wise list” was created, which provides medication recommendations based on efficacy, safety, cost-effectiveness and suitability, as well as environmental impact criteria. This list is distributed to doctors and made publicly available.</td>
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<tr>
<td>Environmental classification schemes</td>
<td>Similar to product eco-labelling, environmental classification schemes allow doctors to make informed prescription choices.</td>
<td>The Swedish Association of Pharmaceutical Industry (Läkemedelsindustriföreningens Service AB) developed an environmental classification scheme, which so far covers ca. 200 APIs. Information is accessible online for consumers and prescribers.</td>
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A survey conducted in the Netherlands concluded that 17.5% were unaware that liquid medicines should not be flushed. (Dutch Sustainable Pharmacy Coalition, 2020)
Policy recommendations

Policies to address pharmaceutical waste should take a lifecycle approach, including source-directed, user-orientated and waste management focused measures, targeting the full range of stakeholders and using a combination of voluntary, economic and regulatory instruments.

**Prevention**

1. **Prevent waste from unused or expired medicine**
   The first priority is to prevent unused or expired medicine. A number of approaches can help avoid the generation of pharmaceutical waste, such as improved disease prevention, precision medicine and improved dimensioning of packaging sizes.

2. **Assess possibilities for redistribution**
   Marketplaces and redistribution platforms for unused close-to-expiry-date medicine provides better matching of supply and demand and contribute to waste prevention and economic savings.

**Collection**

3. **Consider whether separate collection is needed to reduce risks of environmental contamination or abuse**
   Separate collection of unused or expired medicine can help to control potential negative impacts on the environment and public health. In particular liquids, creams and ointments risk to be flushed down the drain and enter waterways. In countries, where state-of-the-art household waste incineration is not widespread and waste is being landfilled this also risks environmental contamination from landfill sites. Furthermore, separated collection can help to reduce risks of abuse or accidents by third parties accessing household bins to recover unused or expired medicine.

4. **Consider the use of an extended producer responsibility (EPR) scheme, where separate collection is needed**
   If a separate collection system is deemed relevant, EPR schemes have shown to be an effective approach to finance environmentally sound collection and treatment that is in line with the polluter-pays principle. Drug take-back should be available to consumers all year-round at convenient collection points and free of charge to minimise transaction costs compared to other disposal routes. Pharmacies have shown to be suitable collection points. Targets and regular review periods can ensure an economically efficient functioning of Producer Responsibility Organisations (PROs) in EPRs. For instance, the French EPR law accredits PRO mandates in a five-year cycle.
5. Increase awareness about proper disposal routes

Well-focused communication campaigns are essential to increase awareness about proper disposal routes.

**Key elements for impactful communication are:**
- Identify the target group and the optimal communication channel and set up indicators and benchmarks to monitor the effectiveness of the campaign.
- Focus on liquid pharmaceuticals, as studies indicate that this product group is still often discarded via the sink or toilet.
- Visible sorting instructions on the packaging contributes to the awareness about take-back facilities.
- Nudging is a strong tool for behavioural change. Programs such as the ‘bonus points’ given by pharmacies in Sweden motivate citizens to return unused or expired medicine to pharmacies.
References


Cyclamed (2019), Cyclamed - Annual Report 2018

Finnish Environment Institute (2020), Good practices for take-back and disposal of unused pharmaceuticals in the Baltic Sea region

Finnish Pharmacy Association (2016), Lääkejätettä syntyy jopa 100 miljoonan euron arvosta vuodessa - Suomen Apteekkariliitto


These Policy Highlights are based on the OECD Publication *Management of Pharmaceutical Household Waste: Limiting Environmental Impacts of Unused or Expired Medicine*. 

The report provides an overview of sources, pathways and risks of unused or expired medicine, in the context of overall pharmaceutical leakage into the environment. It also outlines measures to reduce the amount and impact of unused or expired medicine.


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