The use of pharmaceuticals has led to considerable improvements in human and animal health. As a consequence of disposal also needs to be considered, making pharmaceuticals a waste management concern. While the disposal of waste pharmaceutical residues through the wastewater stream is widely studied, there are limited data on the disposal of unused pharmaceuticals. It is essential to ascertain why such a paucity of data exists, to identify the disposal strategies that would be accepted by the community and to incorporate this knowledge into an educational campaign. An understanding of current disposal practices and the relevance of the various routes of unused pharmaceutical entry into the environment can help inform policy development and ensure that the disposal methods are adequate to protect human health and the environment. These considerations were the focus of an online survey of current attitudes and practices related to the use and disposal of medication conducted within Malta and the Republic of Ireland in early 2012. 1130 response were received. Although located within different European regions, the health systems of the two countries are similar; the total annual expenditure per capita on health at US$4952 and US$4264 in Ireland and Malta respectively. However, costs for a General Practitioner (GP) visit in Ireland are around 4–5 times those in Malta.

Identifying the source of non-required medications

The main issue related to entry of non-ingested pharmaceuticals into the environment concerns the disposal of unused or unwanted medication. Ideally, all medication that has been purchased should be taken until the course is finished. However, a significant proportion of the population fails to completely consume medications (88% in the present study) and keeps them at their home (Kuspis and Krenzelok, 1996). This indicates that they either buy extra or do not finish their medications, with 88% of those surveyed confirming this. Medication use is also a significant determinant for medication storage, with a higher level of medication intake corresponding to increased medication storage. In addition, a significant consideration is that as the population ages, use of Long Term Illness (LTI) medications was found to increase, with respondents older than 46 years old being twice as likely to be on LTI medication (41%) than those under 45 (20%). Such a scenario also yields issues related to medication disposal once they pass away, especially where a prescription for multiple months is filled. In addition, pharmaceutical development in the area of LTI management is ever increasing, which further increases LTI medication usage.

What happens to unwanted medications currently?

The most common disposal practice within the countries surveyed was disposal with the domestic solid waste (57% liquids, 68% pills), followed by disposal in the municipal septic system (28% liquid, 14% pills). Environmentally, disposal within the sewage system is likely to cause the greatest impact upon water bodies. Because wastewater treatment plants (WWTP) are largely not engineered for the removal of pharmaceuticals (Braud et al., 2009). However, although disposal within the sewerage system is the second-most common means for disposal, most respondents (47%) perceive such a means of medication disposal to be the worst method of pharmaceutical disposal.

A possible means of managed disposal is to return unused medication to a GP or pharmacy. However, in this survey, take-back to GPs was least often selected as the best means of disposal. In particular, twice the number of Maltese compared to Irish respondents ranked it in last position. This is likely due to the health care structure in Malta, whereby the GP does not have a nurse or receptionist in the office. Therefore, returning unused pharmaceuticals to the GP is time consuming and potentially costly for the GP. Although less than 10% of respondents return their unused pharmaceuticals to the pharmacy, most perceive it to be the best option. The main motivators for respondents that already dispose of their unused medications at pharmacies are safety and environmental health concerns. The most common reason for not returning unused medicines to pharmacies was a lack of awareness (78%). The fact that the facilities are too far away was the least selected option (3%), indicating that if a pharmacy take-back system is implemented, the network currently in place is probably sufficient in both countries. A few respondents were concerned that the pharmacist might resell them; but, 22% of the respondents who do return medications to the pharmacy do so for potential reuse. Therefore, if a take-back option for disposal is to be promoted, information on the end point for the returned pharmaceuticals is an important consideration.

Why do people act the way they do?

A further consideration when developing policies and programs on the disposal of unused pharmaceuticals is the level of public awareness. This may explain discrepancies between actual practices and perceived best practices by the general public. While educational campaigns are the major approach in awareness building, it is of concern that only 7% of Maltese respondents and 21% of Irish respondents have ever been advised on the best way for medica-
tion disposal (Fig. 1), indicating that strategies for educational campaign implementation need to be rethought.

While a considerable number of Irish respondents have obtained advice from pharmacists (33%), this proportion is substantially lower in Malta (14%). Therefore, an initial awareness campaign targeted towards pharmacies might be appropriate. Of interest is that the least common method of obtaining information is through the GP, most likely due to the different focus of doctors being on completing prescribed medicine rather than on their disposal. Therefore a take-back to GP system is likely to be unsuccessful.

A factor that may contribute to the dearth of information reaching the general public is a lack of consensus on the optimal approach to the disposal of unused medications (Cook et al., 2012), which may be driven by environmental considerations, human health risks (including suicide prevention), costs or practical considerations. Cook et al. (2012) reported that, based on current knowledge, a 100% solid waste disposal programme for pharmaceuticals is the ‘better option’ as it results in lower costs and emissions, while increasing convenience and a chance of compliance. Indications for higher compliance are also reflected in the present study, since this is the preferred disposal method for most respondents.

Another consideration in developing targeted campaigns is an understanding of the demographic variations in awareness. For example, in Malta only 5% of respondents under 45 years of age have received advice, compared to 22% of respondents over 46 years old. In Ireland the major determinant for whether respondents have received information is the level of education. Therefore, an educational campaign in these countries should initially target these sectors of society that are not receiving advice.

Considering the environment

It is necessary to determine how the general public perceives the effect of disposal practices on the environment, as this could influence compliance. Scientific evidence points towards the major source of pharmaceuticals to surface waters is a result of excretion following normal use. However, only 15% of respondents consider this to be the major source, with most respondents (47%) perceiving the major source to be the flushing of unused medications into the sewage system. Within both systems, pharmaceutical company wastewaters are considered to be the major source of pharmaceuticals in the environment by 27–31% of respondents. The higher than expected perception of the importance of pharmaceutical company wastewaters for these respondents could be because the pharmaceutical industry is a major industry in both countries. Such a perception might not be as acute within other countries where the pharmaceutical industry does not play such a major role.

What now?

Although the case study focused on two countries, a number of factors are likely to be universal. This study showed that while only a very small proportion of respondents currently return pharmaceuticals to the pharmacy, this is perceived to be the best disposal option. Therefore, it is likely that a take-back to pharmacy system would receive the greatest acceptance. In addition, only 3% of the respondents stated that distance to a pharmacy is a reason for non-return of pharmaceuticals, indicating that the network currently in place is likely to be sufficient. It is the lack of awareness of the possibility to return pharmaceuticals to a pharmacy that was most commonly cited as a reason for non-return, but this is complicated by a lack of clarity among the scientific community in relation to the optimum unused pharmaceutical disposal method. It is important that a consensus is reached about this, which can then be used to form the basis of educational campaigns concerning pharmaceutical disposal.

The authors acknowledge the financial support of the Marie Curie Initial Training Network (ITN) funded by the EU Framework 7 People Programme, ATWARM (Advanced Technologies for Water Resource Management, ITN No. 238273).

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