# Sustainability and medicines waste: investigating public attitudes towards the reuse of medicines returned to community pharmacies

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## DECLARATION

I, Hamza Alhamad, confirm that this is my own work and that the use of all material from other sources has been properly and fully acknowledged.

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## DEDICATION

To my lovely father and mother for their endless love, encouragement, and unconditional support. Thank you my parents, you encouraged me to travel oversees to further my postgraduate studies and finish my PhD successfully in a time you actually both needed me to look after you.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| A | Attitude |
| ABPI | Association of the British Pharmaceutical Industry |
| AD | Attitude Direct measure |
| AMOS | Analysis of a Moment Structures |
| ANOVA | Analysis of Variance |
| APIs | Active Pharmaceutical Ingredients |
| ATC | Anatomical Therapeutic Chemical Coding |
| BB | Behavioural Belief |
| BBIN | Behavioural Belief Indirect measure |
| BNF | British National Formulary |
| CB | Control Belief |
| CBIN | Control Belief Indirect measure |
| CD | Controlled Drug |
| CFA | Confirmatory factory analysis |
| CFI | Comparative Fit Index |
| CNS | Central Nervous System |
| CPs | Community Pharmacies |
| CV | Content validity |
| CVS | Cardiovascular System |
| EWC | European Waste Catalogue |
| EWFD | European Waste Framework Directive |
| GIT | Gastrointestinal Tract |
| GPs | General Practitioner Surgeries |
| HBM | Health Belief model |
| HCW | Health-care waste |
| I-CVI | Item-level Content Validity Index |
| ID | Intention Direct measure |
| IJPP | International Journal of Pharmacy practice |

| | |
|---|---|
| JFDA | Jordanian Food and Drug Administration |
| KMO | Kaiser–Meyer–Olkin |
| MDS | Monitored Dosage System |
| MI | Modification Indices |
| MIMS | Monthly Index of Medical Specialties online |
| MRQ | Medicine Reuse Questionnaire |
| MUR | Medicines Use Reviews |
| NAO | National Audit Office |
| NB | Normative Belief |
| NBIN | Normative Belief Indirect measure |
| NFI | Normalized Fit Index |
| NHS | National Health System |
| NIC | Net Ingredient Cost |
| NICE | National Institute for Health and Care Excellence |
| NMS | New Medicine Service |
| NSAIDs | Non-Steroidal Anti-Inflammatory Drugs |
| OTC | Over The Counter |
| PBC | Perceived Behavioural Control |
| PBCD | Perceived Behavioural Control Direct measure |
| PCA | Principal Component Analysis |
| PMT | Protection Motivation Theory |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| PSNC | Pharmaceutical Services Negotiating Committee |
| RMSEA | Root Mean Square Error of Approximation |
| S-CVI | Scale-level Content Validity Index |
| S-CVI/Ave | Scale-level Content Validity Index Average |
| S-CVI/UA | Scale-level Content Validity Index, Universal Agreement |
| SEA | Standard Error Attitude |
| SEI | Standard Error Intention |
| SEM | Structural Equation Modelling |
| SEPBC | Standard Error Perceived Behavioural Control |

| | |
|---|---|
| SESN | Standard Error Subjective Norm |
| SN | Subjective Norm |
| SND | Subjective Norm Direct measure |
| SNF | Saudi National Formulary |
| SPSS | Statistical Package for Social Sciences |
| SD | Standard Deviation |
| TA | Thematic Analysis |
| TACT | Target, Action, Context, and Time |
| TLI | Tucker Lewis Index |
| TPB | Theory of Planned Behaviour |
| TRA | Theory of Reasoned Action |
| TTM/SoC | Trans-Theoretical Model of Health Behaviour Change or Stage of Change |
| UAE | United Arab Emirates |
| UK | United Kingdom |
| US | United State |
| USA | United State of America |
| UTI | Urinary Tract Infection |
| VIF | Variance Inflation Factor |
| WHO | World Health Organisation |
| YHEC | York Health Economics Consortium |

## DISSEMINATION OF FINDINGS

### Publication

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## ABSTRACT

### Introduction

The financial cost of medicinal waste in the UK is estimated as £300 million per year for prescribed medicines. Medicines reuse relates to the idea that unused prescribed medicines returned by one patient to a pharmacy can be re-dispensed to another patient as a strategy for reducing medicinal waste in the UK.

### Aims

This thesis aimed to capture people's beliefs and intentions towards reusing medicines that are returned to the pharmacies, using the Theory of Planned Behaviour (TPB).

### Methods and analysis

The research uses a mixed method study design, using qualitative interviews to identify themes that were then classified using TPB (phase 1), in order to develop and validate a Medicine Reuse Questionnaire (MRQ) (phase 2), which was used to quantify the views of a large sample of respondents drawn from around the UK (phase 3) about medicines reuse.

### Results and discussions

Medicines reuse was defined and people's ideas about advantages and disadvantages, who might approve or disapprove, and factors that would impede or facilitate reusing medicines were mapped using thematic analysis. The MRQ was valid (confirmatory factor analysis showed the factor loading of all items to be >0.5; the item level content validity index was > 0.8) and reliable (Cronbach's alpha measuring internal consistency of the direct measures

items was >0.7; Pearson's correlation measuring stability of the indirect measures items was >0.5). A total of 1,003 valid responses were analysed and subjective norms had the strongest positive effect on intentions with standardized path coefficient of 0.55 ($p < 0.001$, n = 1003).

## Conclusion

This research suggests that people living in the UK have positive intentions and could reuse medicine in the future. However, ensuring safety and quality of medicines that will be offered for reuse is vital for people to agree to reuse medicines in the future.

# CHAPTER 1 THESIS OVERVIEW

## 1.1 Overview of the area of the study

Not all medicines that are prescribed to patients are fully used. In the UK, if a prescribed medicine is no longer being used, then conceptually that medicine is considered to be waste, because it ought to be discarded rather than used again. Pharmacies are required to accept the return of used and unused medicinal waste from patients and to dispose of these through appropriate routes (Pharmaceutical Service Negotiating Committee, 2017). Medicinal waste that is not disposed of appropriately has an impact on the environment and poses a risk to human health. In addition to this, the generation of medicinal waste has an economic impact.

The environmental impact of medicinal waste relates to contact with the environment. For example, when unused medicinal waste is improperly disposed of by patients into household garbage, or flush down the sink or the toilet, it can reach the water system and seep into the environment (Tong et al., 2011). The presence of medicinal waste in the environment can have an effect by modifying the physiological function of living creatures, the implications of which are not completely known but, for example, this has been linked to the possible emergence of antibiotic resistant bacteria (e.g. vancomycin resistant enterococci and beta-lactam-hydrolysing *enterobacteriaceae*) and endocrine deactivating compounds (e.g. “feminising effects” of ethinyl estradiol on fish near wastewater treatment works) (Schwartz et al., 2003). In addition, medicinal waste can impact negatively on the environment through the “carbon footprint”.

The financial impact of medicinal waste has been described based on the extrapolated costs of the amount of unused medicinal waste returned to community pharmacies (CPs), general practitioners (GPs), and hospitals, which may even underestimate the total cost of medicinal waste. Nonetheless, the general consensus in the UK is that the estimated extrapolated cost of medicinal waste each year is £300 million (Trueman et al., 2010).

Finally, risk to human health exists if unused medicines stockpiled at home are used by others, for example, for self-medication (Wu and Juurlink, 2014). Self-medication with antibiotics is a common practice in Europe, most often for a sore throat which is caused predominantly by viral infections. The use of antibiotics in this way has an added risk of creating bacterial resistance (an antibiotic-specific risk) without any potential for benefit (Grigoryan et al., 2010). In addition, there is the risk of accidental poisoning, especially if such medicines are used by children. There is also a potential for medicinal abuse especially if the medicines stockpiled are controlled drugs (CDs) or otherwise have addictive properties (Mackridge, 2005).

There are many factors that contribute to medicinal waste. These can be described as avoidable (e.g. excess supply of medicines, errors, and non-adherence) and non-avoidable (e.g. patient death, and treatment prescription changes) causes (Hawksworth et al., 1996; Braybrook et al., 1999; Jesson et al., 2005). The non-avoidable causes of medicinal waste are the most commonly reported in the literature (West et al., 2014).

To reduce medicinal waste, one approach is to prevent medicinal waste in the first place. For example, strategies devised in order to reduce the generation of medicinal waste include those that address adherence, such as the services of Medicines Use Review

(MUR) and the New Medicine Service (NMS), medicinal waste campaigns, and the use of Monitored Dosage Systems (MDSs). Other strategies also include limiting prescriptions to 28 days' supply, introducing small prescription charges, and medicinal waste campaigns (Jesson et al., 2005; and Trueman et al., 2010). The evaluation of these preventive strategies is limited and there is a distinctive lack of evidence about the effectiveness of these preventive strategies in addressing medicinal waste (Trueman et al., 2010; and West et al., 2014). In addition, these preventive strategies fail to address medicinal waste generated due to unavoidable causes (e.g. medicine adverse reaction, prescriptions being changed or stopped, and patient death) which are considered more common causes of medicinal waste and are estimated to account for more than 50% of medicinal waste generated in primary care (Trueman et al., 2010).

To address the problems of medicinal waste at a waste management level, unused medicinal waste, especially those produced as a result of unavoidable causes could in theory be redistributed to other patients (Jesson et al., 2005; and Trueman et al., 2010). The redistribution of returned unused medicines to other patient is known as 'medicines reuse'. Medicine reuse is potentially an effective approach to reducing medicinal waste as it could address both avoidable and non-avoidable causes of medicinal waste. In this way, medicines reuse can potentially provide a more sustainable use of returned unused medicinal waste, while reducing the environmental impact of current disposal practices (Mackridge and Marriott, 2007). Medicine reuse remains largely unexplored in the UK because unused medicines are not currently permitted to be redistributed to other patient.

Medicine reuse has the potential to be implemented in the UK if its feasibility is explored. Firstly, as described earlier, medicine reuse would have the potential to address both

avoidable and non-avoidable causes of medicinal waste compared to current interventions that are not able to address the non-avoidable causes of medicinal waste. Secondly, people in the UK, anecdotally, often ask for medicines they are returning to a pharmacy to be reused. In fact, a NHS sustainability survey carried out by Ipsos MORI in 2011 reported half of the respondents were likely to accept re-issued medicines returned to pharmacies (NHS Sustainable Development Unit, 2011). Finally, there is precedence for medicines reuse in other countries. For example, in the United States unused medicines are collected and redistributed to patients who are less able to afford the cost of medicines (Cauchi, 2012).

The application of medicine reuse in the UK depends on many factors, which are explored in this thesis. However, it is worth pointing out some existing supporting evidence relating to the idea of medicines reuse. For example, the characteristics that may allow or preclude medicines reuse include the visual aesthetic characteristics of unused medicines and this is an area where some research already exists. These characteristics can in theory be qualitatively assessed by pharmacists to determine if the unused medicine is suitable for reuse (e.g. oral solid dosage form medicines that are in sealed blister packaging, unopened, and within the expiry date). Data from a UK study by Mackridge and Marriott (2007), a Swedish study by Ekedahl (2003), and Omani study by (Al-Siyabi and Al-Riyami, 2007) showed that the majority of the returned unused medicinal waste were unopened and within the expiry date, and probably suitable for reuse. In addition, the authenticity of returned medicines is an issue. There will be an opportunity to check for counterfeit and/or tampered medicines by using a unique identifier (a 2-dimension barcode) and an anti-tampering device in the near future. This is because in the UK, manufacturers will be

required to place the safety features (i.e. a unique identifier of a 2-dimension barcode and an anti-tampering device) on the packaging of most prescription medicines and certain non-prescription medicines by 9 February 2019 (European Medicines Agency, 2016).

Before medicines reuse is introduced there is a need to formally examine the general public's views about this concept and whether they are willing themselves to reuse medicines returned to CPs in the future. No previous research has formally examined people's beliefs about medicine reuse. This thesis set out to investigate people's beliefs and attitudes as well as intentions to reuse returned unused medicines in the future through a psychological approach. The Theory of Planned Behaviour was selected as the psychological framework for this research, enabling people's behavioural, normative, and control beliefs about medicine reuse to be explored and measured. TPB allows a range of question to be answer such as what would or would not encourage people to reuse medicines, what do people think in terms of advantages and disadvantages of reusing medicines in the future, would social norms (e.g. what family and friends think and do) influence people's decision to reuse or not reuse medicines, and what are the factors or circumstances that make it difficult or easy for people to reuse medicines (Ajzen, 1991; Ajzen, 2006; and Ajzen, 2011).

## 1.2 Aims and objectives

The aim of this thesis was to capture people's beliefs and intentions toward reusing medicines in the future by applying a mixed method study design and using the Theory of Planned Behaviour (TPB) as a tool to develop the Medicine Reuse Questionnaire (MRQ).

The objectives were first to use qualitative interviews to define medicines reuse as a behaviour; and identify behavioural, normative, and control beliefs about medicines reuse (phase 1). Then, to construct, validate, pilot and develop the MRQ (phase 2) to finally capture the views of respondents drawn from around the UK about medicines reuse and their willingness to reuse medicine in the future (phase 3).

## 1.3 The importance of doing this research in the UK and internationally

Medicinal waste is a growing problem in the UK and in different parts of the world. Other studies have investigated the causes of medicinal waste, impact of medicinal waste, and the interventions to reduce medicinal waste (Trueman et al., 2010; and West et al., 2014). Historically, the UK medicinal waste management strategies that have occurred in CPs such as disposal of medicinal waste and intermittent medicines take-back campaigns are at the foot of what is known as the waste hierarchy, meaning that they address the least environmentally favoured option of 'disposal' (EWFD, 2008; and UK Department of Health, 2013). As described earlier, a range of waste management strategies in the UK have been applied. These include MURs, MDS, educational campaigns, and limiting prescriptions to 28 days. These attempt to address the avoidable causes of medicinal waste such as non-adherence, excess supply and stockpiling, and prescription and dispensing errors (Jesson et al., 2005; and Trueman et al., 2010). The evaluation of these preventive strategies is limited and there is a distinctive lack of evidence about the effectiveness of these preventive strategies in addressing medicinal waste (Trueman et al., 2010; and West et al., 2014). Moreover, these preventive strategies fail to address medicinal waste generated due to unavoidable causes (e.g. medicine adverse reaction, prescriptions being changed or stopped), which are considered more common causes of medicinal waste (West

et al., 2014) and are estimated to account for more than 50% of primary care medicinal waste (Trueman et al., 2010).

To address the problems of current waste management practices, unused medicinal waste, especially those produced as a result of unavoidable causes could in theory be redistributed to other patients (Jesson et al., 2005; and Trueman et al., 2010). The redistribution of the returned unused medicines to other patient is known as medicines reuse. Medicine reuse could have a positive financial impact (Mackridge and Marriott, 2007) as well as a potential to provide a more sustainable solution to medicinal waste, while reducing the environmental impact of current disposal practices (Daughton, 2003). There is therefore a rationale for wanting to implement medicine reuse as an intervention because it can address both avoidable and non-avoidable causes of medicinal waste. However, medicines are not currently permitted to be redistributed to other patient and the idea of medicines reuse remains largely unexplored in the UK.

There is precedence for medicines reuse in other countries. For example, in the United States unused medicines are collected and redistributed to patients who are less able to afford the cost of medicines (Cauchi, 2012). Therefore, medicine reuse has a potential and could be applied to reduce medicinal waste in the UK taking into consideration the safety and stability of the returned unused medicines, people's uptake of the idea and agreement to reuse medicines in the future, pharmacist time and agreement, and whether pharmaceutical company would be willing to involve in medicine reuse process.

## 1.4 Background information about the researcher

Prior to starting the PhD study, the researcher HA was new to research involving qualitative methods and psychological theories. HA is a clinical pharmacist who has a clinical experience and was involved only in one clinical based research project during his study for MSc. degree in clinical pharmacy, international practice and policy. Therefore, HA underwent a one week training course at Kingston University about "Doing and Communicating Qualitative Research". The training courses involved introduction about principles and practicalities of qualitative research, introductions about grounded theory, discourse analysis, thematic analysis, interpretative phenomenological analysis (IPA), qualitative interviews (individual and focus groups), and training on how to do thematic analysis. In addition, HA attended short courses in a relation to qualitative studies as part of the University of Reading Research and development Program (RRDP). Finally, HA read many research papers that focused on qualitative interviews, thematic analysis and the application of Theory of Planned Behaviour (TPB).

## 1.5 Overview of the thesis

This chapter has provided a summary and overview about the area of study (i.e. medicinal waste and medicine reuse), the economic and environmental impact of medicinal waste, and the risk to human health, the different intervention applied to reduce medicinal waste, the potential for medicine reuse compared to previous interventions, and the factors the affect the application of medicine reuse. In addition, this chapter has set out the aims and objectives of the research, and detailed information about the importance of this research in the UK and internationally, as well as providing background information about the researcher HA.

Chapter 2 provides background information about medicinal waste, health-care waste in the UK National Health Service (NHS), the handling of household medicinal waste by pharmacist, disposal practices for medicinal waste, the impact of medicinal waste (i.e. the environmental, economic impact, and risk to human health), types and causes of medicinal waste (i.e. avoidable and non-avoidable causes), the waste hierarchy and the preventive strategies to reduce medicinal waste, and medicine reuse as an intervention to reduce medicinal waste. In addition, chapter 2 details a structured review of the different therapeutic classes and dosage forms of medicinal waste reported in the UK and Internationally. Finally, chapter 2 provides information about the gap in research about medicinal reuse.

Chapter 3 provides an overview about the different psychological theories relevant to understanding people's beliefs and intentions toward reusing medicines in the future, an overview of the common health related psychological theories (e.g. Health Belief Model, Protection Motivation Theory, Trans-theoretical Model of Behaviour Change and Stage of Change, Theory of Reasoned Action, and Theory of Planned Behaviour), assessment of the ability to use the TPB to predicts people's behavioural beliefs and their intentions to reuse medicines in the future, and support for the application of TPB to predict people's behavioural beliefs and their intentions to reuse medicines in the future .In addition, chapter 3 describes the steps applied to manage the development of TPB Medication Reuse Questionnaire (MRQ). Finally, chapter 3 provides information about the overall conclusion, recommendation, and future work of the study.

Chapter 4 describes phase 1 of the study and details the qualitative study (i.e. elicitation study), study compliance with ethical standard and study setting, participants recruitment

process, thematic analysis, and data collection and analysis. In addition, chapter 4 defines medicine reuse as a behaviour, and identifies behavioural, normative and control beliefs in a relation to medicine reuse as a behaviour. Finally, chapter 4 provides information about the different themes obtained inductively, then categorises these themes deductively according to TPB into three major categories; consequences of medicine reuse, exemplar and anti-exemplar individuals or groups, and expectations about medicine reuse.

Chapter 5 describes phrase 2 of the study and details the development of Medicine Reuse Questionnaire (MRQ) using TBP. In addition, chapter 5 details information about the development of MRQ items of the indirect measures, direct measures and intentions of TPB, and also the background factors items. Chapter 5 describes in details the validity (i.e. content validity, and Confirmatory Factory Analysis) and reliability (i.e. internal consistency of direct measures of TPB using Cronbach's alpha and test retest of the indirect measures of TPB using Pearson correlation) process of MRQ. In addition, chapter 5 describes the two piloting processes that result in the final version of the MRQ which was composed of 48 items.

Chapter 6 describes phase 3 of the study and the final amendment of the Medicine Reuse Questionnaire (MRQ) before it was disseminated to a large representative sample of respondents drawn from around the UK to capture their perception toward reusing medicines in the future. In addition, chapter 6 describes the use of the online platform, the online panel, and the involvement of a Market Research Company in the recruitment process. Finally, chapter 6 describes the descriptive results of this study, the hypothesis testing, and the utility of TPB and its predictive power for capturing people's beliefs and intentions to reuse medicines in the future.

Chapter 7 provides a thesis summary of the key findings of phases 1, 2 and 3, discusses the significance and limitations of the research, the potential impact of the research, and recommend future work.

# CHAPTER 2 GENERAL INTRODUCTION AND LITERATURE REVIEW

## 2.1 Health-care Waste in the UK National Health Service

One way in which waste is generally thought of is as anything discarded by an individual, household or organisation. More formally, waste is defined by the European Waste Framework Directive (EWFD 2008/98/EC) as *"*any substance that the holder discards or is required to discard*"* (EWFD, 2008). Accordingly, the term waste encompasses a complex mixture of different substances, some of which are considered hazardous to people's health. In addition to this, the generation, transport and disposal of waste may present threats to the environment and to public health, the impact of these indirect effects being dependent on the types and implementation of waste management options. Therefore, in the UK, the primary aim in the management of waste is to guarantee that it is processed, treated, and disposed of in a safe and cost-effective manner that does not negatively impact on people and the environment (Palmer, 2014).

Waste can result from a multitude of sources. For example, health-care organisations and facilities produce many different types of waste as a result of their daily activities, such as diagnostic activities, and preventive, palliative and curative treatments. Health-care waste (HCW) is an umbrella term for the waste produced by research facilities, laboratories, and organisations that provide health-care services in addition to waste generated in a person's home where health and social care is provided. HCW can include bandages, swabs, sharps, blood, medicines and incontinence pads (Royal College of Nursing, 2014). There are two main types of HCW as shown in Table 2.1 ; hazardous and non-hazardous HCW. Hazardous HCW is named as such because it is considered to have infectious or some other

properties that can cause harm to the environment and humans if it is mishandled. In contrast, non-hazardous HCW includes waste that does not pose any particular biological, chemical, radioactive or physical hazard. When HCW is a medicine or contaminated with a medicine it is referred to as medicinal waste (Royal College of Nursing, 2014; and World Health Organisation, 2011).

Medicinal waste includes "expired, unused, spilt, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of appropriately" (UK Department of Health, 2013). Medicinal waste, similar to general HCM, can be hazardous or non-hazardous and has three main classifications (Royal College of Nursing, 2014):

**I. Hazardous medicines (cytotoxic or cytostatic)**

These are medicines that have one or more hazardous properties meaning they are, for example toxic, carcinogenic, toxic for reproduction or mutagenic, warranting classification as hazardous waste. Hazardous medicines include most hormonal preparations, some anti-viral drugs and some antibiotics. Because they are classified as hazardous waste, the regulations state that they must be segregated from other medicines when being handled as waste.

**II. Non-hazardous pharmaceutically active medicines**

These are pharmaceutically active products, so while they have a pharmacological impact on people or the environment, they do not have any of the hazardous properties associated with cytotoxic or cytostatic medicines described above. Therefore, they are not considered to be hazardous.

### III. Non-hazardous, non-pharmaceutically active medicines

These are non-pharmaceutically active products, such as infusion bags containing saline or sugar solutions, which have no hazardous properties and also are unlikely to have a pharmacological impact on people or the environment.

**Table 2.1 Classifications and definitions of health-care waste**

| | |
|---|---|
| **Hazardous.** Waste that can cause harm to the environment and human health if it is mismanaged. It can include clinical waste, infectious waste, cytotoxic and cytostatic medicines, chemicals and hazardous substances, radioactive diagnostics, therapeutic materials, and X-ray photos. | |
| **Clinical waste** | Waste from health-care activity that 1. Contains viable micro-organisms or their toxins which are known or believed to cause disease in humans or other living organisms. 2. Contains or is contaminated with a medicine that contains a biologically active pharmaceutical agent. 3. Is a sharp, or a body fluid or other biological material (including human and animal tissue) containing or contaminated with a dangerous substance (based on regulations for the classification, packaging and labelling of dangerous substances). |
| **Infectious waste** | Waste contaminated by blood and its secondary products, cultures and supplies of infectious agents, waste from isolated patients, any infected thrown away diagnostic samples with blood and body fluids, and contaminated materials and equipment such as swabs, bandages, disposable medical devices, respectively. |
| **Cytotoxic and cytostatic waste** | Any medicinal product that possesses any one, or more, of the following hazardous properties: 1. Toxic 2. Carcinogenic 3. Toxic for reproduction. 4. Mutagenic. This definition is wide and may include many medicines such as hormone-based preparations, antimicrobial substances such as chloramphenicol eye drops, as well as cancer-treating agents (chemotherapeutics and anti-neoplastic drugs). |
| **Non-hazardous (general waste).** Waste that does not pose any particular biological, chemical, radioactive or physical hazard. It includes offensive/hygiene waste, non-cytotoxic and non-cytostatic medicines, domestic waste, packaging waste, recyclable waste, and food waste. | |
| **Offensive waste, sometimes called hygiene waste** | Waste that is non-infectious and not clinical, but may cause offence due to the presence of recognisable health care waste materials, body fluids, or odour. |
| **Non-hazardous medicinal waste** | Pharmaceutically and non-pharmaceutically active |

*Adapted from (Royal College of Nursing, 2014; and World Health Organisation, 2011).

## 2.2 The handling of household medicinal waste by pharmacies

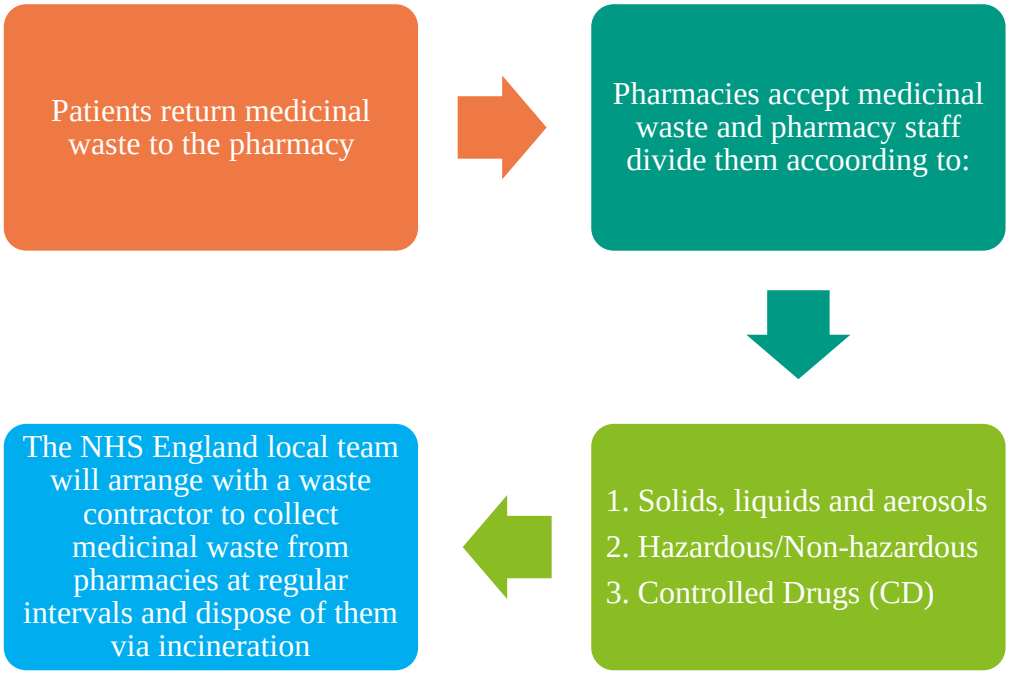
In the UK, if a prescribed medicine is no longer being used, then conceptually that medicine is considered to be waste, because it ought to be discarded rather than used, say, by another patient. This is because medicines that have been dispensed to patients, even if unused, are not currently allowed to re-enter the pharmaceutical supply chain. The Royal Pharmaceutical Society's guidance for Pharmacists states that "medicines returned to a pharmacy from a patient's home, a nursing or residential home must not be supplied to and used again by any other patient and have to be destroyed"(Royal Pharmaceutical Society, 2016) . One technical reason is uncertainty about the biochemical integrity of medicines on leaving the formal distribution chain; for example, storage conditions in a patient's home may degrade the active ingredients. The potential for counterfeit medicines to enter the pharmaceutical supply chain is another concern. All of these considerations mean that, currently, medicines no longer being used transform, at least conceptually, into medicinal waste.

Pharmacies are required to accept the return of used and unused medicinal waste from patients and medicinal waste returned to a pharmacy automatically necessitates appropriate disposal by the pharmacy (Pharmaceutical Service Negotiating Committee, 2017). As part of this process, the Pharmaceutical Service Negotiating Committee recommends that pharmacy staff should ask people presenting medicinal waste to fill in an unwanted medicines card to guarantee that there are no items such as chemicals or products that may be incompatible with other products in the pharmaceutical waste bin and which cannot be safely disposed of. The pharmacists then (as required by NHS England or the waste contractor) should divide the medicinal waste into solids (including ampoules and

vials), liquids and aerosols (Pharmaceutical Service Negotiating Committee, 2017). Any household medicinal waste that is acutely toxic, carcinogenic, mutagenic or toxic for reproduction needs to be segregated by pharmacy staff. However, it is no longer necessary to segregate medicines originating in the pharmacy from those returned by households. Instead, the returned unused medicinal waste must be properly described with appropriate European Waste Catalogue (EWC) Codes and if any Controlled Drug (CD) is identified, it must be isolated and denatured using a CD denaturing kit before being destroyed so that it cannot be recovered or reused. (Pharmaceutical Service Negotiating Committee, 2017).

The NHS England local team is responsible for arranging for a waste contractor to collect medicinal waste from pharmacies at *regular* intervals. The waste contractor usually uses high temperature (incineration) as a treatment process for medicinal waste. The processes described in this section is shown in Figure 2.1.

**Figure 2.1 Summary of the UK processes associated with the safe disposal of household-generated medicinal waste**




Despite the existence of this formalised process for the handling and disposal of medicinal waste, public awareness of this service is limited. Patients do not always return their medicinal waste to a pharmacy, instead they may store their unused medicines at home, or dispose of the medicines themselves (Tong et al., 2011). This is described in more detail in the section that follows.

## 2.3 Disposal practices for medicinal waste

Medicinal waste that is not returned to pharmacies is either stockpiled at home or disposed of by patients into the household trash, or by flushing down the toilet or disposal through the sink (Murray et al., 2005; Bound et al., 2006; Tong et al., 2011; and Vellinga et al., 2014). The various methods used by patients to dispose of their medicinal waste have been studied in the UK and around the world. A systematic review about disposal practices

relating to medicinal waste from around the world reported that patients most commonly dispose of their medicinal waste via the household garbage (Tong et al., 2011). Similarly, results from UK studies have consistently confirmed that patients most commonly dispose of their medicinal waste via household waste (garbage). For example, in the study by Bound et al. (2006), 63.2% of the people in the South East of the UK disposed of their medicinal waste in the household waste bin, 11.5% disposed of these via the sink or toilet, with only 21.8% returning their medicinal waste back to the pharmacy. Similarly, data from a public survey in Scotland reported that 37% of prescription only medicines and 56% of over the counter medicines were disposed of into the garbage, while 44% of prescription only medicines and 34% of over the counter medicines were flushed into the drain (Murray et al., 2005).

Evidence from the above studies indicates that the majority of medicinal waste is disposed of improperly with only a small amount returned back to pharmacies. There is some evidence to show that people's decision to dispose of their medicinal waste inappropriately, instead of returning them back to the community pharmacy, can be influenced by factors such as their knowledge and awareness of economic and environmental consequences of improper disposal practices. For example, Vellinga et al. (2014) investigated the effect of the advice given to patients in Ireland by their health-care provider on medicinal waste disposal practices. *Before* the advice was given to patients by a healthcare provider 72% of the respondents reported they disposed of their medicinal waste improperly; for example via household waste (51%), into the sink (29%) and into the toilet (14%). *After* advice was given to patients by a healthcare provider, 75% of the respondents reported they disposed of their medicines properly by returning them to the pharmacies. This study supports the

idea that people advised about medicinal waste and how to best dispose of it are more likely to take their medicinal waste to pharmacies rather than inappropriately disposing of them at home.

## 2.4 Impact of medicinal waste

Medicinal waste, as well as being disposed of inappropriately, can be accumulated at home, posing a risk to human health, and to the environment and it also has a financial cost too. Reducing medicinal waste can potentially reduce its negative financial and environmental impact as well as reducing the risks of accidental poisoning and medicinal abuse and other ill effects on human health.

### 2.4.1 The impact of medicinal waste on human health

Risk to human health exists if unused medicines stockpiled at home are used by others, for example, for self-medication. There is the risk of accidental poisoning, especially if such medicines are used by children. There is also a potential for medicinal abuse especially if the medicines are CDs or have addictive properties (Mackridge, 2005). In addition, patients may self-medicate for a new illness with medication previously prescribed for a different illness (Wu and Juurlink, 2014). For example, self-medication with antibiotics is a common practice in Europe, most often for a sore throat which is caused predominantly by viral infections. The use of antibiotics in this way has an added risk of creating bacterial resistance (an antibiotic-specific risk) without any potential for benefit (Grigoryan et al., 2010). Finally, there is the broader idea that patients who do not take their medicines as prescribed, creating medicinal waste, impact negatively on their own health by not treating

their condition (Osterberg  and Blaschke 2005) – although this is clearly a ‘cause’ of medicinal waste it is nonetheless associated with it.

### 2.4.2 Environmental impact of medicinal waste

The environmental risk of medicinal waste relates to contact with the environment. There is evidence that pharmaceuticals are found in the water environment around the world (Kümmerer, 2009). The likely pathways that lead to the presence of pharmaceuticals in water include human excretion, veterinary excretion, agriculture uses, pharmaceutical company waste and improper disposal of medicinal waste (Bound and Voulvoulis, 2005; Radhakrishna et al., 2014).

The presence of medicinal waste in the environment is considered more difficult to control compared to other pollutants due to the fact that medicines are often resistant to usual biodegradation pathways and generally last for an undefined time in the environment because of, for example, long half-lives (Jones et al., 2002). The presence of medicinal waste in the environment can modify the physiological function of living creatures, the implications of which are not completely known but, for example, this has been linked to possible emergence of antibiotic resistant bacteria (Schwartz et al., 2003), and endocrine deactivating compounds (Lange et al., 2001). Data from Schwartz et al. (2003) confirmed the development of bacterial resistance as vancomycin resistant enterococci and beta-lactam-hydrolysing enterobacteriaceae were cultivated from all wastewater biofilms examined. Moreover, in a study by Lange et al. (2001), the increased presence of pharmaceuticals was linked with reproductive and developmental abnormalities in various types of fish. For example, there is the “feminising effects” of endocrine-disrupting compounds, such as ethinyl estradiol on fish near wastewater treatment works. The results

from these studies illustrate the negative effect of the presence of medicinal waste on the environment.

Despite the fact that medicinal waste is present in the water environment and with observed toxicological effects, the concentrations are generally at trace levels in the order of nanograms to micrograms per litre (Kümmerer, 2009) and below the levels thought to cause harm to humans in most cases (Bound et al., 2006). However, the unknown effect of the chronic release of medicinal waste in the environment creates uncertainty and it cannot be ruled out that the accumulative presence of medicinal waste in water is at levels that may be considered serious and pollutant to water receivers. There is yet another environmental impact of medicinal waste, which is less direct but also important.

Medicinal waste can impact negatively on the environment through the "carbon footprint". The carbon footprint is "the measure of the impact of individuals, organisations or community activities on the environment by calculating all the greenhouse gases produced in these activities and measuring them in the unit of carbon dioxide" (Wright et al., 2011). The NHS has one of the biggest carbon footprints of any organisation in Europe. Data from the National Audit Office (2015) reported that procurement is the largest contributor (61%) of the total NHS carbon footprint with pharmaceuticals (35%) as the largest component of procurement emissions. The majority of pharmaceuticals (80%) are linked to prescriptions by primary care and community services, then acute services (13%), and mental health services (5%) (National Audit Office, 2015). In order to have an indicative view of the carbon impact of particular medicines, the Association of the British Pharmaceutical Industry (ABPI) collaborates with the Carbon Trust to help pharmaceutical companies (such as AstraZeneca, GlaxoSmithKline, Janssen (J&J), Eli Lilly, and Pfizer) launch a

carbon foot print tool to *estimate* the carbon footprint for Active Pharmaceutical Ingredients (APIs), transport and distribution, formulation and packaging, retail and use phase and finally the disposal of the packaging (ABPI, 2013). This tool could potentially help pharmaceutical companies to provide an estimation of the carbon footprint of a range of medication (ABPI, 2013). But in the meantime, it is certainly acknowledged that pharmaceuticals, and in turn, medicinal waste, have an impact on the environment through carbon footprint.

In 2014 *NHS England* and *Public Health England* produced a vision for a sustainable health and care system that "works within the available environmental and social resources protecting and improving health now and for future generations." It aims to reduce carbon emissions, and minimise waste & pollution to contribute to the Climate Change Act target to reduce carbon emissions by 34% by 2020. Pharmaceuticals represent 16% of the entire health and social care system carbon footprint and reducing this figure currently relies on improving medicines use and reducing waste (Sustainable Development Unit, 2014).

### 2.4.3 Economic impact of medicinal waste

The number of prescribed medicines and the NHS prescription bill has increased substantially in the past decade. According to data from the Health and Social Care Information Centre published in 2016, 1,083.6 million prescription items were dispensed by UK CPs in 2015, with an increase of 1.8% (19.1 million items) compared to that dispensed in 2014 (Prescribing and Medicines Team Health and Social Care Information Centre, 2016). This is an increase of 50.4% (363.4 million) on the number of the item dispensed in 2005 (720.3 million items). The Net Ingredient Cost (NIC) of prescribing in 2015 was £9,266.5 million increased by of 4.7 % (£414 million) from 2014. This is an

increase of 16.8% (£1330.0 million) in the costs from 2005, when the total cost was £7,936.6 million (Prescribing and Medicines Team Health and Social Care Information Centre, 2016). These figures shows that both the number of prescriptions and the NIC of prescribing, and ultimately the medicine bill, have increased significantly in the past decade, so it is quite important from a financial perspective too that medicines are not wasted and/or are used in a cost-effective manner.

The financial impact of medicinal waste is possibly even destructive to the health-care economy. The general consensus in the UK is that the estimated extrapolated cost of medicinal waste each year is £300 million (Trueman et al., 2010). The estimated costs of medicinal waste in the UK was calculated based on the extrapolation of the costs of the medicinal waste being returned to Community Pharmacies (CPs) and General Practitioner (GP) surgeries which may underestimate the real value of the costs of medicinal waste as it did not take into account the cost of unreturned medicinal waste that were disposed of by patients or stockpiled at home.

A number of other studies too from inside (six) and outside (eight) of the UK have estimated the costs of medicinal waste, summarised in Table 2.2. In these studies, the estimated costs of medicinal waste varied widely due to factors such as numbers of the returns made, the type and cost of medicines returned, the study duration (which ranged from four weeks to seven months), and the number of CPs, hospital pharmacy, and GP clinics involved. Studies from outside the UK involved a higher number of CPs compared to UK studies with the exception of the study by Mackridge and Marriott (2007).

In the UK the estimated extrapolated cost of medicinal waste in 2007 was in the range of £37-100 million per year (Hawksworth et al., 1996; Mackridge and Marriott, 2007; and National Audit Office Report, 2007). More recent research, mentioned above, reported that a figure of £300 million to be the estimated extrapolated cost of medicinal waste each year in the UK (Trueman et al., 2010). This is three times higher than the £100 million reported by the National Audit Office Report (2007). It would be fair to assume that with prescription volume increases, the volume of medicinal waste will increase too. This would suggest that the cost of medicinal waste is increasing and probably uncontrolled. Therefore, it is important for the NHS to investigate for more sustainable solutions of medicinal waste. This is in light of the financial challenges the NHS is facing; the NHS five year forward view estimates there to be 30 billion pounds funding gap by 2020/21 (NHS, 2014).

**Table 2.2 Summary of research studies evaluating the economic impact of medicinal waste from different countries**

| Study | Study setting and duration | Study method | Country | Main Findings |
|---|---|---|---|---|
| Hawksworth et al. (1996) | 30 CPs over duration of 1 month | Cross sectional questionnaire | UK | A total of 1,091 items were returned by 366 patients with estimated value of £37 million |
| Braybrook et al. (1999) | 18 pharmacies over 8 weeks | Small pilot study | Wales/UK | The total cost of reported 1,428 items returned was £19,059. |
| Langley et al. (2005) | 8 CP and 5 GPs over duration of 4 weeks | Cross sectional observational study | UK | A total of 340 items were returned (42 to GPs and 298 to CPs). The total cost of returned items was £3,986 to GPs and £3,751 CPs. |
| Mackridge and Marriott (2007) | 51 CPs and 42 GPs over duration of 8 weeks | Cross sectional study | UK | A total of 3,765 items were returned by 910 patients with estimated value of £75 million |
| National Audit Office Report (2007) | Based on previous analysis conducted by department of health | Previous analysis conducted by department of health | UK | Proposed that each year an estimate of £100 million value of unused returned medicine. |
| Trueman et al. (2010) | 403 of the 466 items identified in the public survey were able to be priced. Costs were identified /item using British National Formulary (BNF). | Public survey | UK | Estimated that the annual cost of the primary and community care medicines wastage in UK NHS was around £300 million per year (£ 250-300 million per year). |

| Study | Study setting and duration | Study method | Country | Main Findings |
|---|---|---|---|---|
| Cameron (1996) | 58 CPs in Alberta (8% of provincial total) over duration of 8 weeks | Self-reporting questionnaire | Canada | The estimated cost of the unused medicines returned was $60,350. The extrapolated cost for 750 CPs is in Alberta during the same 8 week period was $716,400. |
| Morgan (2001) | Sample of 73 of Hampshire retirement community citizens aged 65 years or older. over duration of 7 months | Cross sectional pilot survey | US | The total cost of 2,078 wasted medicines was US $ 201,100 with mean annual cost of wasted medication was $30.47/person (range = $0-$131.56). Individual costs were modest, but if $30/individual demonstrate a low estimate of average annual cost of waste, the US extrapolated cost was estimated to be not less than $1 billion per year. |
| Abou-Auda (2003) | A total of 1641 families participated (1554 from Saudi Arabia, 87 from other countries) | Questionnaire / Pilot study | Saudi Arabia, capital cities of Kuwait, Oman, Qatar, and United Arab Emirates | The estimated cost of unused medicines by families in Saudi Arabia capital cities of Kuwait, Oman, Qatar, and United Arab Emirates (U.A.E) was $150 million. |

| Study | Study setting and duration | Study method | Country | Main Findings |
|---|---|---|---|---|
| Coma et al. (2008) | 38 CPs over duration of 3 months | Cross sectional questionnaire | Spain | The estimated cost of returned medicines was €8,539.9. The extrapolated cost for the 20,461 CPs in whole Spain was €129.6 million |
| El-Hamamsy (2011) | 20 CPs over duration of 1 month | Questionnaire (Closed-ended questions used only) | Cairo/Egypt | The total wholesale price of returned drugs calculated at 10,988.84 Egyptian pounds (around $1,962.32 US) |
| Ibrahim et al. (2012) | 60 CPs over a period of one month | A cross sectional descriptive study | Alexandria/ Egypt | The estimated total cost of 657 returned drugs to CPs was $8,348.5. |
| Hassali et al. (2012) | Two parts (over duration of 6 months): Medicine wastage in the patients' home.<br><br>Medicine wastage by the volunteer at the pharmacy desk. | A descriptive study of two parts: 1) Community -based prospective randomised trial. 2) Patients returned their medicinal waste to the hospital pharmacy. | Malaysia | The total cost of the returned medications within 6 months was MYR 59,566.50 (Malaysian ringgit) with a monthly average of about MYR 9,927.75. the extrapolated cost for one year of the medications returned was MYR 119,133.00 |

| Study | Study setting and duration | Study method | Country | Main Findings |
|---|---|---|---|---|
| | | | | |
| Law et al. (2015) | A web-based survey (Phase I) at one health sciences institution between April and June 2011 and paper based survey (Phase II) planned drug take-back events at three CPs. | A cross-sectional observational two phased study | Southern California/US | The total cost of medicinal waste was $152,014.89 from both phases with the total extrapolated cost to US national level ranging from $2.4 to $5.4 billions. |

## 2.5 Types and causes of medicinal waste

There are many factors that contribute to medicinal waste and these have been described in the literature in different ways. These factors were described as avoidable or non-avoidable by Jesson et al. (2005) who derived the description from Hawksworth et al. (1996) and Braybrook et al. (1999) (Table 2.3). At least half of the causes of medicinal waste are considered unavoidable and the majority of the avoidable causes of medicinal waste are potentially as a consequence of poor health-care services and practices (Jesson et al., 2005). In addition, Trueman et al. (2010) included the concept of non-adherence, i.e. people not taking their medicine as intended (whether intentional or unintentional). Compliance, an older term, and adherence are terms used to describe medicine-taking behaviour by the patient. Compliance is defined as the extent to which the patient's behaviour *matches* the prescriber's recommendations. Adherence in turn is the extent to which the patient's behaviour *matches the agreed* recommendations from the prescriber. Adherence is the term preferred by many over compliance because of its emphasis on the need for agreement (Horne, 2006).

To summarise, factors that contribute to causing medicinal waste can be split into three types (Jesson et al., 2005; and Trueman et al., 2010):

1. **Preventable (avoidable) medicinal waste**: patient stockpiles their medicines in case they may need to use them in the future. Or items from a repeat prescription are dispensed even if the patient is no longer taking them.
2. **Non-preventable (non-avoidable) medicinal waste**: death of a patient, or a change in treatment leading to the previous medicines being no longer required.
3. **Medicinal waste related to non-compliance and/or non-adherence**:

- **Non-compliance**: patient does not take medicines as prescribed. For example, taking incorrect doses of medicines or at irregular intervals, or not taking them at all.
- **Non-adherence (intentional)**: patient stops taking medicines. For example, due to adverse side effects or personal beliefs.
- **Non-adherence (unintentional)**: patient stops taking medicine, or fails to take at correct intervals. For example, due to forgetfulness.

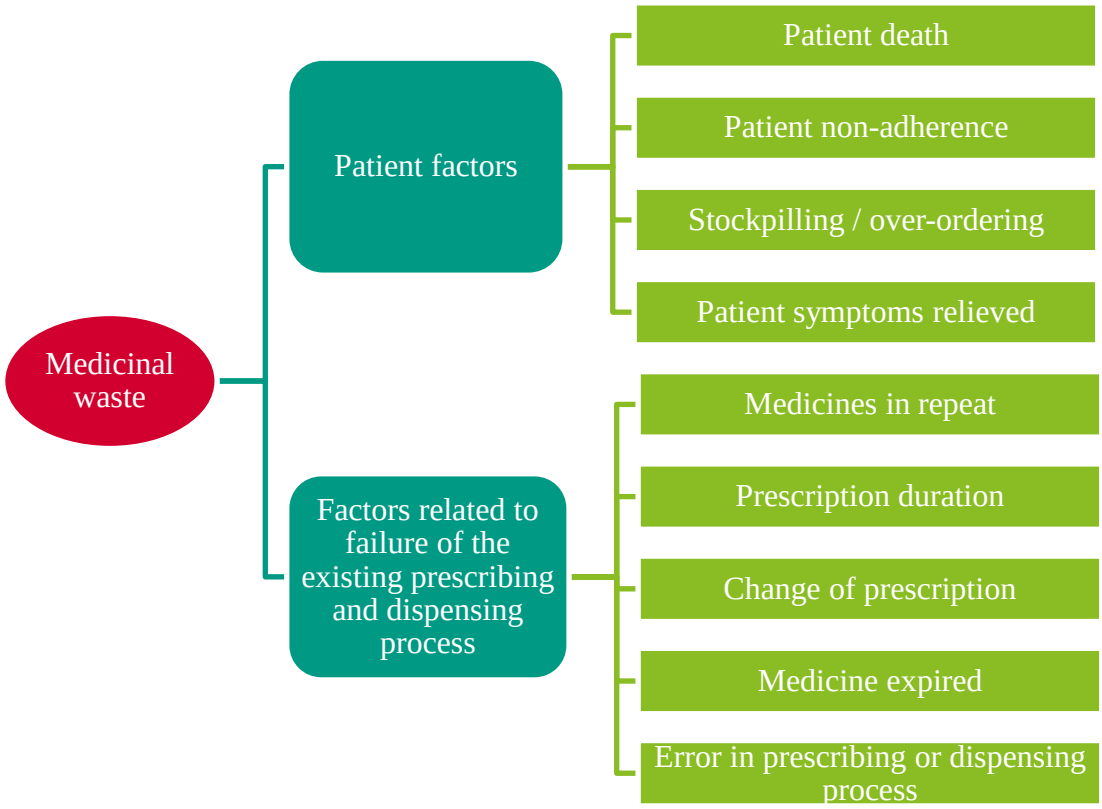
**Table 2.3 Common causes of medicinal waste and the extent to which they are preventable (avoidable).**

| Causes of medicinal waste | Extent to which they are avoidable or not |
|---|---|
| Patient death | Unavoidable |
| Medicines changed or stopped by the prescriber due to clinical reasons | Unavoidable |
| Medicine adverse reactions | Unavoidable |
| Medicines passed their expiry date | Avoidable |
| Prescription and dispensing errors | Avoidable |
| Excess supply, over ordering and stockpiling | Avoidable |
| Patient non-compliance and non-adherence | Avoidable |

* Adapted from Jesson et al. (2005), cited by (Hawksworth et al., 1996; and Braybrook et al., 1999)

The factors that contribute to causing medicinal waste can be also be thought of as related to patients (such as patient behaviour and non-adherence), or failure of the existing prescribing and dispensing process (such as error in prescription order or supply). These factors are summarised in (Figure 2.2). It is clear that the process of prescribing, dispensing, and the patient as a receiver all play a part in causing and creating medicinal waste (Trueman et al., 2010). These are described in the sections that follow.

**Figure 2.2 Causes of medicinal waste can occur as a result of patient factors or failure in prescribing and dispensing process (system factors), adapted from Trueman et al. (2010).**




### 2.5.1 Patient death

In the treatment of chronic conditions, the aim is to maintain the patient's health and provide the best quality of life for them. This may necessitate medicines for the long term, and a larger number of medicines (polypharmacy) to treat comorbidities, and continuous modification of the prescriptions as the conditions progress (Mackridge, 2005). But if a patient dies, their current unused medicines and any previous medicines that have been stockpiled are sometimes returned to CPs or GPs as medicinal waste. Five cross sectional UK studies (Cook, 1996; Hawksworth et al., 1996; Langley et al., 2005; Mackridge and Marriott, 2007; and Coma et al., 2008) examined medicine returns to CPs and GPs and

consistently reported that patient death is a common reason for medicinal waste. More recently, a systematic review investigating the causes of medicinal waste reported patient death as the second most commonly cited reason for medicinal waste (West et al., 2014).

### 2.5.2 Changes in the treatment prescription

Patients can sometimes experience an adverse drug reaction or their medicines are no longer considered to be effective. An adjustment to the dose, or stopping or changing the treatment may therefore be necessary to fulfil the required patient outcome. When medicines are prescribed for long durations such as three months, larger amounts of unused medicines could potentially accumulate as a result of treatment being changed (Jesson et al., 2005; and Mackridge and Marriott, 2007). This is because, for example, if a 3-month quantity is prescribed, dispensed, but then changed half-way through the 3-month period, there is scope for a large quantity to be wasted.

Changing the treatment is a considerable cause of medicines being returned unused by patients. It is reported as a common cause of medicinal waste in many UK studies (Cook, 1996; Hawksworth et al., 1996; Langley et al., 2005; Mackridge and Marriott, 2007; and Coma et al., 2008). A recent systematic review investigating the causative factors of medicinal waste by West et al. (2014), reported medicine being changed as the most commonly cited reason for medicinal waste.

### 2.5.3 Patient non-adherence

Patient non-adherence is another of the most commonly cited reason for medicinal waste. A report by York Health Economics Consortium (YHEC) and the School of Pharmacy, University of London (Trueman et al., 2010), comprehensively discussed the issues of

compliance and adherence, linking them to medicinal waste. In this report they divided the causes of medicinal waste into intentional non-adherence (such as beliefs and side effects), unintentional non-adherence (such as omission, forgetfulness), and factors not related to adherence (such as patient death, medicines passed beyond the expiry date, or medicine prescription changed). Data from Trueman et al. (2010) illustrated that a dislike of taking medicines, previous experience and/or anticipation of future adverse side effects (cited Benson and Britten, 2003; and Elliott et al., 2007), inconvenience of medicine taking (cited Eatock and Baker, 2007), belief that medicines are ineffective (cited Jesson et al., 2005), depression (cited Bambauer et al., 2007), and lack of professional support for appropriate medicine use (cited Bultman and Svarstad, 2000) can all result in patient non-adherence, therefore generating medicinal waste. Moreover, non-adherence differs according to medicine type and medical condition. For example, non-compliance is more likely to happen with preventive medicines rather than those used for symptomatic relief (cited Piette et al., 2006) and with chronic conditions (over 70% of prescriptions in the UK were via repeat prescription) more than acute conditions (Trueman et al. (2010).

### 2.5.4 Excess supply of medicines

Medicines are often prescribed in conditions where there is no clinical need or in an amount which is excessive for the needs of the patient, resulting in excess supply of medicines and therefore, medicinal waste. This poor prescribing and dispensing practice is referred to as system failure rather than patient factors (Trueman et al., 2010). Excess supply of medicines was reported as a cause of medicinal waste but less commonly compared to patient death, treatment changes, and patient non-adherence (West et al., 2014).

### 2.5.5 Error in prescribing or dispensing processes

Although it is less usual for errors to occur in the prescribing and dispensing process, errors are still made in small numbers resulting in patients receiving improper medicines (Mackridge, 2005). Dispensing errors occur in relation to a range of elements including strength of medicine, medicine type, medicine quantity, dosage form and package labelling (Chua et al., 2003). The overall quantities of improper dispensed medicines are relatively small. In the study by Mackridge and Marriott (2007), they accounted for less than 1% of medicines returned to CPs and GPs for disposal.

### 2.5.6 Other causes of medicinal waste

In the literature, other less common causes of medicinal waste were also reported such as patient unsure why medicines are prescribed (Braund et al., 2008; and Braund et al., 2009), unclear instructions (Abahussain et al., 2006; Braund et al., 2008; Braund et al., 2009; El-Hamamsy, 2011; and Ibrahim et al., 2012), and unknown causes of medicinal waste (Coma et al., 2008; and El-Hamamsy, 2011).

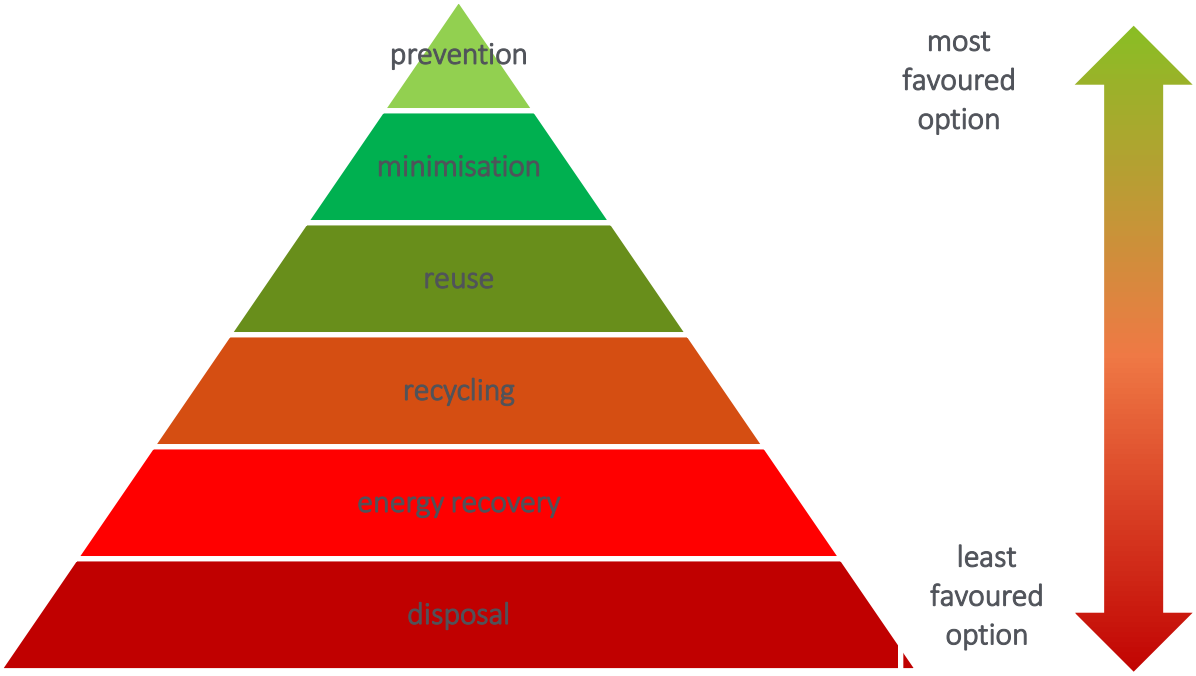
The above causes of medicinal waste can lead to either therapeutic effect loss and/or material waste. Therapeutic loss happens when the effects of the medicines are reduced by the patient's failure to take medicines as prescribed. Non-adherence can lead to therapeutic loss when medicines are taken, but not as prescribed.

The next section examines ways in which the problem of medicines waste has been tackled up to now.

## 2.6 The waste hierarchy and preventive strategies to reduce medicinal waste

To reduce medicinal waste, one approach is to prevent waste in the first place. Preventing waste is at the top of the Waste Hierarchy, a grading system which "ranks waste management options according to what is best for the environment" (EWFD, 2008; and UK Department of Health, 2013), with 'prepare for reuse', 'recycle', 'other recovery' and 'disposal' all following 'prevention' (the preferred choice) in decreasing order of preference (Figure 2.3).

**Figure 2.3 Waste hierarchy, adapted from (EWFD, 2008; and UK Department of Health, 2013).**




A number of strategies have been considered to reduce the generation of medicinal waste as the 'prevention' or 'minimisation' levels. Most of these strategies focused on improving patient adherence such as Medicines Use Reviews (MURs), and the use of Monitored Dosage System (MDS). Other strategies also include limiting prescriptions to 28 days'

supply, introducing small prescription charges, and medicinal waste campaigns (Jesson et al., 2005; and Trueman et al., 2010).

### 2.6.1 Medicines Use Reviews

The Pharmaceutical Services Negotiating Committee (PSNC) describes MURs as a process which covers a variety of interventions undertaken by an accredited pharmacist who runs structured adherence-centred reviews with patients taking multiple medicines for long-term conditions. The MUR was first introduced in 2005 to help identify and resolve problems in medicine taking to improve medicines adherence and stop the supply of unnecessary treatments, which theoretically, has the potential to decrease medicinal waste and produce financial savings for the NHS (Jesson et al., 2005; and Trueman et al., 2010). There is however a lack of data relating to the cost-effectiveness of this practice, which may indicate its limited success. A study from the School of Pharmacy, University of East Anglia by Wright (2016), described the problems related to MURs to be largely derived from insufficient training of the pharmacists, service introduction and targeting, and lack of support from GPs with negative GP perceptions about the value of MURs which may result in non-implementation of recommendations and reduced cost effectiveness of the service. In a contrast, Trueman et al. (2010) argued that with better targeting of MURs to the most vulnerable patients, MURs could prove highly effective. Nonetheless, it is reasonable to state that thus far, the MUR has not been seen as an effective solution to the problem of medicines waste.

### 2.6.2 Monitored dosage systems (MDS)

Elderly patients with long-term chronic conditions in particular are thought to be more vulnerable to medicines non-adherence. Evidence suggests that physical or organisational difficulties lead to the generation of medicinal waste in this population in particular (Beckman et al., 2005). A practice whereby medicines are dispensed by pharmacists into multi-compartments labelled clearly with patient and medication details, is increasingly used in care homes to aid and simplify the administration of medicines for such patients (Trueman et al., 2010). Monitored dosage systems (MDSs) or sometimes referred to as multi-compartment medicine devices, or even multi-compartment compliance aids are in theory used to aid adherence (Trueman et al., 2010). Two available examples of MDS were described in a study by Barber et al. (2009); the *cassette* MDS which contains multiple medicines in one compartment and *blister* MDS which contain only one dose of medicine in each compartment.

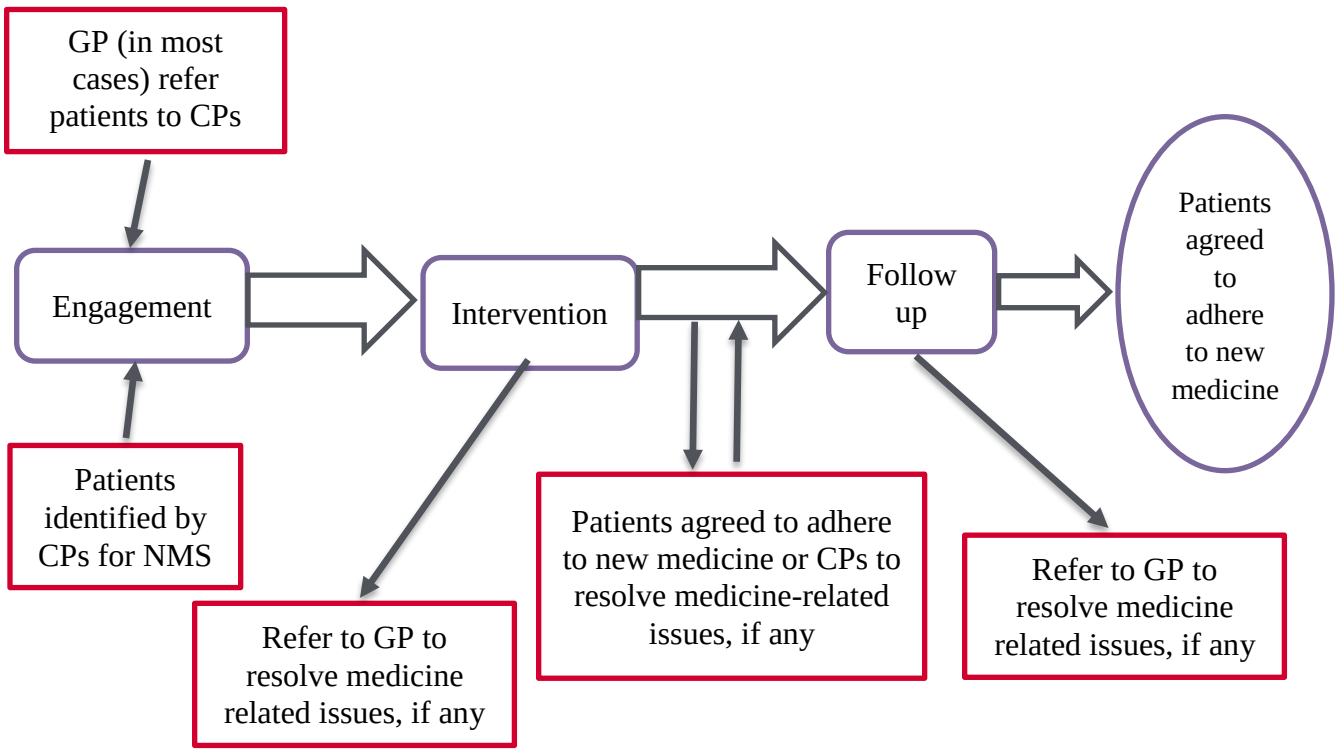
Although the idea is that well targeted use of MDSs could increase cost-effectiveness, improve medicine taking, enhance adherence, and thus achieve better desired medicinal outcomes, there is uncertainty about this because of a lack of cost-effectiveness data especially in patients who have a poor adherence record (Brunenberg et al., 2007). Moreover, this system could be responsible for a fair proportion of medicinal waste itself. For example, when a prescription is changed, all items already supplied in such devices have to be thrown away (Trueman et al., 2010). In addition, MDSs are limited to solid dosage forms and do not take into account other dosage forms, such as liquids or inhalers, which account for over 40% of doses administered in care homes (Barber et al., 2009).

### 2.6.3 New Medicine Service (NMS)

The New Medicines Service (NMS), a newer CP service developed from the MUR, provides support for patients who are *newly prescribed a medicine* for a long-term condition such as asthma, COPD, type 2 diabetes or hypertension, or who are taking anticoagulant therapy or anti-platelets. Patients with a chronic condition who require a change of dose or formulation of a current medicine do not count and are not eligible for the NMS. The NMS concentrates on specific patient groups and conditions, and consists of three stages; patient engagement, intervention, and follow up (Figure 2.4).

The NMS is similar in its aims to the MUR, in that it aims to help improve patients adherence to medicines with a potential to reduce medicinal waste. Although the NMS is cost effective and increases the number of patients who are adherent to their medicines by around 10% (Elliott et al., 2014), there is a lack of data that link this intervention directly to reducing medicinal waste.

**Figure 2.4 Standard care pathway of patients receiving the NMS from a community pharmacist (CP). GP: General Practitioner. Adapted from Elliott et al. (2014).**



### 2.6.4 Limiting prescription to 28 days' supply

Limiting prescription duration to 28 days can contribute to reducing the generation of medicinal waste (Trueman et al., 2010; cited Hawksworth et al., 1996). A UK study by Hawksworth et al. (1996) calculated the volumes of medicinal waste returned to CPs and found that it was reduced by a third when the repeat prescription duration was shortened to 28 days only. Although this study identified an opportunity to reduce medicinal waste, it did not take into consideration other consequences associated with shortening prescription duration such as the added dispensing cost (pharmacy charges), the added time spent by the pharmacists to prepare the prescription, which is perhaps diverting pharmacists away from other more useful activities, the added patient travel costs, and the inconvenience the patient may experience (ordering monthly prescriptions and having these dispensed) which may increase the risk of the patient becoming non-adherent to the treatment (Domino et al., 2004). In the study by Domino et al. (2004), the increase in patients' travel costs and the additional dispensing fees paid to pharmacies in USA was included in considering the benefits of reducing the length of prescriptions. This study suggests supported the idea that prescription durations up to three months may be a better option.

In addition, evidence from an Italian study found that shortening prescription durations in hypertensive patients reduced adherence rates in those who had previously been taking their medicines appropriately (Atella et al., 2006). The effect on adherence was also noticed in the UK report by Trueman et al. (2010), where the application of 28 days prescribing in some circumstances reduce patient adherence to their medicines. More recently, a research by Davies and Taylor (2013), showed that by imposing the 28 days prescription, an extra £150 million in dispensing fees a year is added to the NHS costs in

addition to the loss of disease control as a result of non-adherence. The authors of this study added that the extra £150 million is considered far more than any possible saving that can be generated by imposing the 28 day prescription. In general, there is no consistent evidence in the literature which shows a reduction in medicinal waste due to limiting prescribing to 28 days.

### 2.6.5 Adding extra prescription charges

The idea of adding extra prescription charges is that when patients have to pay more prescription charges for their medicines, they would value their medicines more and this would be a nudge to reduce medicinal waste. This may not be true as the increase in prescription charges does not always have beneficial effects on reducing medicinal waste (Donyai, 2014). Instead it may negatively affect patient adherence by disheartening patients from taking their medicines which may lead to unfavourable health consequences. In addition, the concept of adding charges to medicines may not affect rich patients, instead it may add pressure on patients who cannot afford their medicines (Trueman et al., 2010). Currently, there is no data from the UK that support the idea of adding prescription charges to reduce medicinal waste.

## 2.7 Medicinal waste management strategy and medicines reuse

Historically, the UK medicinal waste management strategies that have occurred in CPs such as disposal of medicinal waste and intermittent medicines take-back campaigns remain at the foot of the waste hierarchy, i.e. at ‘disposal’ (see Figure 2.3) (EWFD, 2008; and UK Department of Health, 2013). As described in the previous section though, a range of waste management strategies in the UK operate at a higher level in the waste hierarchy

and these include MURs, MDS, educational campaigns, and limiting prescription to 28 days. These attempts to address the avoidable causes of medicinal waste such as non-adherence, excess supply and stockpiling, and prescription and dispensing errors (Jesson et al., 2005; and Trueman et al., 2010). The evaluation of these preventive strategies is limited and there is a distinctive lack of evidence about the effectiveness of these preventive strategies in addressing medicinal waste (Trueman et al., 2010; and West et al., 2014). In addition, these preventive strategies failed to address medicinal waste generated due to unavoidable causes (e.g. medicine adverse reaction, prescriptions being changed or stopped, and patient death) which are considered more common causes of medicinal waste (West et al., 2014) and are estimated to account for more than 50% of primary care medicinal waste (Trueman et al., 2010). To address the problems of current waste management practice, unused medicinal waste, especially those produced as a result of unavoidable causes could in theory be redistributed to other patients (Jesson et al., 2005; and Trueman et al., 2010). The redistribution of the returned unused medicines to other patient is known as medicines reuse, an idea that is on the third tier of the waste hierarchy (see Figure 2.3).

Medicine reuse, the third tier in the Waste Hierarchy could have a positive financial impact (Mackridge and Marriott, 2007) as well as a potential to provide more sustainable use of returned unused medicinal waste, while reducing the environmental impact of current disposal practices (Daughton, 2003).

### 2.7.1 Medicine reuse as an intervention to reduce medicinal waste in the UK

Medicine reuse remains largely unexplored in the UK because unused medicines are not currently permitted to be redistributed to other patient. In the UK if a prescribed medicine

is no longer being used, then conceptually that medicine is waste because it ought to be discarded rather than used by another patient. One technical reason is uncertainty about the stability and safety of the returned unused medicines (Mackridge and Marriott, 2007).

In 2007, a UK study by Mackridge and Marriott (2007) investigated returned unused medicines in primary care and showed that a considerable amount of these returns were *unopened* and *within the expiry date*, and probably suitable for reuse. Findings from this study are consistent with results from a Swedish study that looked at medicines returned to pharmacies of which a good amount remained unopened and had not expired (Ekedahl, 2003). The evidence from these studies highlights the potential for medicines reuse. Moreover, patients returning their medicines to pharmacies often voice a wish for these to be reused by others. In fact, an NHS sustainability survey carried out by Ipsos MORI in 2011 reported half of the respondents were likely to accept re-issued medicines returned to pharmacies (NHS Sustainable Development Unit, 2011). There is precedence for medicines reuse in other countries. For example, in the United States unused medicines are collected and redistributed to patients who are less able to afford the cost of medicines (National Conference of State Legislatures, 2012).

The application of medicines reuse in the UK depends on many factors such as safety and stability of returned unused medicines, pharmacist time and agreement to help redistribute the returned unused medicines, and people's uptake and agreement to reuse returned unused medicines. Stability and safety is a major concern. In fact, there are characteristics that may allow or preclude medicines reuse such as the physical and chemical features, and dosage forms (Al-Siyabi and Al-Riyami, 2007). These characteristics could be qualitatively assessed by pharmacists to determine if the medicine is suitable for reuse. Only oral solid

dosage forms are considered potentially suitable (Al-Siyabi and Al-Riyami, 2007). Examples of medicine characteristics and dosage forms for medicines reuse are shown in Table 2.4.

In theory, a formal, quality-assured system for collecting and reusing unused medicines could provide an effective solution for the problem of medicinal waste in the UK, considering medicines reuse has the potential to address both preventable and non-preventable causes of medicinal waste, which current waste management strategies do not address.

**Table 2.4 Examples of medicine characteristics the preclude or allow medicines reuse**

| Reusable medicines | Non-reusable medicines |
|---|---|
| **Medicines intact, and solid oral dosage form** | Ampoules and injectable medicines, suspensions, suppositories, and compounded or reconstituted medicines |
| **Medicines in multi-dose sealed containers from which no doses have been withdrawn** | Medicines that require refrigeration e.g. insulin |
| **Medicines with an expiry date >6 months** | Medicines with an expiry date <6 months |
| **Solid dosage form sealed by manufacturer** | Misbranded or adulterated medicines |
| **Medicines which are stored correctly, with their integrity, packaging or labelling not compromised** | Medicines which are stored incorrectly, and/or with integrity, packaging or labelling compromised (e.g. through environmental damage such as water damage, crushing, broken seal, torn or marked label) |

*Adapted from Al-Siyabi and Al-Riyami (2007).

## 2.8 Toward medicines reuse: structured review of the different therapeutic classes, and dosage forms of medicinal waste reported in the UK and internationally

Knowing information about the different therapeutic classes and dosage forms of medicinal waste can help understand more if these medicines can be reused. For example, it is helpful to know if medicines being returned are solid (thus have the potential to be reused), liquid, injectable or other dosage forms. And whether these medicines are over the counter (cheaper / not critical to NHS costs) or other therapeutic classes that could be more relevant in terms of cost effectiveness. Despite a thorough literature review on the causes medicinal waste (West et al., 2014), financial and environmental impact of medicinal waste (Trueman et al., 2010), disposal practices of medicinal waste (Tong et al., 2011), and the management strategies of medicinal waste, only a few studies have reported the type and therapeutic classes and dosage forms of unused or returned medicinal waste. In this section, a structured review rather than a systematic review of the literature was conducted to report the key findings from the literature on medicinal waste in terms of the most common therapeutic classes of medicinal waste that are returned by patients and their dosage forms. The result from this review was presented at the "Sustainability and You" annual symposium in Brighton (22/06/2016) under the title "*Toward medicines reuse: a structured review of the different classes and dosage forms of wasted medicines reported in the UK and internationally*".

### 2.8.1 Aim

To review and summarise the findings from the literature about the different therapeutic classes and the dosage forms of medicinal waste that are returned by patient to CPs.

### 2.8.2 Methodology and search strategy

A search strategy of electronic databases was carried out over a period of one month in May 2015 (the search strategy was reviewed and updated on July 2017 through which one study was added) to identify reports and studies published in English and related to therapeutic classes and dosage forms of medicinal waste. Electronic databases searched included; PubMed/Medline, Cochrane library, Grey literature (open grey and British library), National Audit Office (NAO), International Journal of Pharmacy practice (IJPP), and NICE evidence. The bibliographies of retrieved references were also searched.

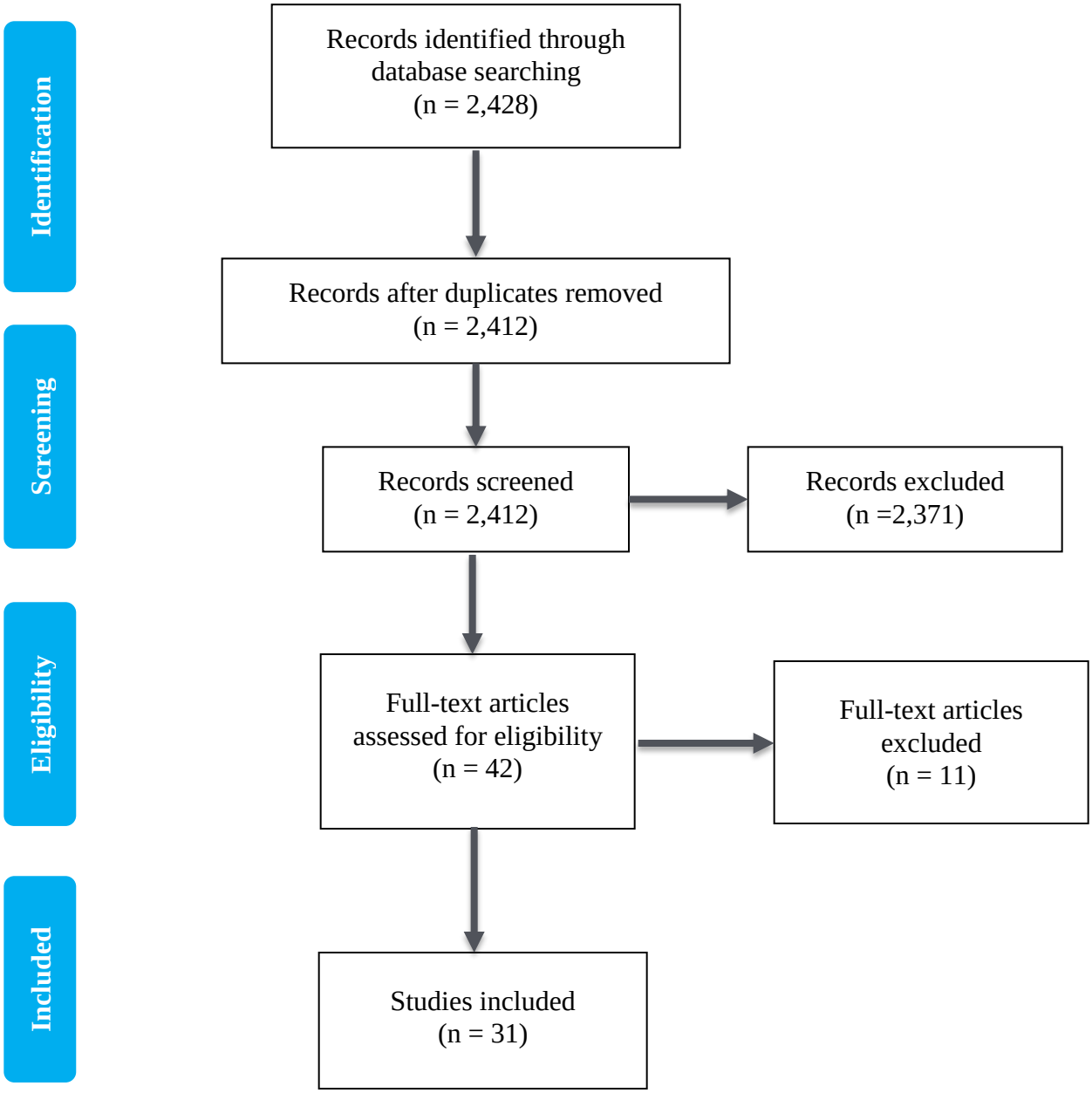
The search used Boolean combinations of a list of terms that included; types of unused medicines OR classes of unused medicines OR dosage forms of unused medicines OR types of medicinal waste OR classes of medicinal waste OR dosage forms of medicinal waste OR types of unused drugs OR classes of unused drugs OR dosage forms of unused drugs OR types of drug waste OR classes of drug waste OR dosage forms of drug waste.

The inclusion criteria was to select studies that reported the therapeutic classes and dosage forms of the returned medicinal waste, either dispensed by a prescription or purchased over the counter (OTC), or a medicine sample that had expired (or had no clear expiry date) or was never fully consumed (or not being used at all), and those limited to the English language. The exclusion criteria was for studies that were not published in English, and studies that did not described medicinal waste, instead described medical waste, medical devices waste, clinical tissue waste.

A list of 2,428 candidate studies was generated as a result from searching the electronic databases. Study selection was carried out initially by screening all the study titles and

abstracts, and then by fully screening the candidate forty two studies against structured review inclusion and exclusion criteria through which thirty one studies were finally included (Figure 2.5).

**Figure 2.5 Literature search scope shown using the PRISMA flow chart, adapted from The PRISMA Group (2009)**



### 2.8.3 Results

Data obtained from the retrieved studies included demographic information of the participants, the types and dosage forms of medicinal waste, study settings and sample size, and the time duration of the collection of the returned medicines which varied from 4 week up to 12 months all summarised in Appendix 1 and Appendix 2.

A total of thirty one studies published between 2002 and 2015 and comprising data from different countries from around the world (Australia, Austria, Egypt, Ghana, India, Jordan, Kuwait, Malaysia, Mexico, New Zealand, Oman, Qatar, Saudi Arabia, Spain, Taiwan, Tanzania, Thailand, United Arab Emirates, United Kingdom, United States of America) were reviewed.

In most of these studies, medicinal waste was returned by patients to CPs, GP clinics, hospitals, or sometimes collected via medicine take back and medicinal waste campaigns. However, four studies, two from India (Gupta et al., 2011; and Aditya and Singh, 2013), one from Malaysia (Ali and Ibrahim, 2009), and one from Ghana (Aboagye and Kyei, 2014), used a *survey* to collect information about the therapeutic classes and dosage forms of medicinal waste without the need of face to face or telephone contact with the participants to collect information about the returned medicinal waste. The methodologies used and the targeted populations are summarised in Appendix 1.

#### 2.8.3.1 *Demographics of the participants*

**Gender** was not reported in the majority of the studies. Seven studies (23% of the retrieved studies) described the gender of the participants, and it was not clear if there is a gender differences associated with the return of medicinal waste. For example, in the studies from

Egypt, the number of people who returned their medicinal waste happened to be more male than female. Data from the seven studies that described gender reported that medicinal waste were more commonly associated with females in three studies (Wongpoowarak et al., 2004; Coma et al., 2008; and Kagashe et al., 2014) and more commonly with males in three studies (Gupta et al., 2011; Ibrahim et al., 2012; and Aboagye and Kyei, 2014). Moreover, one study from Malaysia out of seven (Ali and Ibrahim, 2009) was with female students only (Appendix 1).

**Age** of participants was described in 15 studies out of 31 (48%). The age profile of the participants varied in these studies, and the range was up to 81 years. Only seven studies out of the 15 found a noticeable connection between the mean number of the returned items per patient and their age. The majority of medicinal waste was reported to be collected from participants with the age range of 60-80 years (Langley et al., 2005; Braund et al., 2008; Braund et al., 2009; Guirguis, 2010; and Ibrahim et al., 2012). This may simply indicate that this age group has more need for medicines or may be more diligent in returning them when no longer needed. Two studies (Aditya and Singh, 2013; and Aboagye and Kyei, 2014) found that the majority of medicinal waste were reported to be collected from participant's age range 20-40. The reason is that these studies were among *students* in which the age range will most likely be 20-40 years. It is difficult to generalize that the age range of 60-80 years was associated with more medicinal waste as age data was absent from the majority of the studies (52%).

#### 2.8.3.2 *Dosage forms of returned medicinal waste*

Dosage forms of the returned medicinal waste were investigated in 18 studies out of the 31 (58%) (Appendix 2). The dosage forms reported were oral solid dosage forms (tablets,

capsules, granules, powders, and lozenges), liquids (syrups, injections, eye drops, suspensions, emulsions, and lotions), semisolids (ointments, creams, gel, paste and suppositories), and others such as inhalers, sprays, patches, strips, and chewing gum. Oral dosage forms were the most common reported dosage form in eleven studies out of 18 (61%) with percentages ranging from 40.6%−95.6% of all medicinal waste. Moreover, tablets were reported to be the commonest of the oral dosage forms.

One study from Oman by Al-Siyabi and Al-Riyami (2007) reported that during handling of the dosage forms most of them appeared in a suitable condition for reuse and were still in their original container. However, some changed in colour, consistency and odour and were not suitable for reuse. Results from a UK study by Mackridge and Marriott (2007) were consistent with the Omani study in which many of the returned medicinal waste were reported to be in a condition suitable for reuse as assessed by a pharmacist. Findings from the Omani and the UK study are important considering unused medicines are sometimes arranged to be sent for reuse in developing countries and such considerations are also important for implementing medicines reuse in the UK in the future.

#### 2.8.3.3 *Therapeutic category of the returned medicinal waste*

With the exception of two studies (Braund et al., 2009; and Kagashe et al., 2014) in which only prescribed medicines were included in their analysis, the majority of the studies include both prescribed and over the counter medicines in the analysis. Moreover, only three studies (Garey et al., 2004; El-Hamamsy, 2011; and Gracia-Vásquez et al., 2015) included medicine samples in addition to prescribed and over the counter medicines.

The majority of the studies (28 out of the total 31) reported the returned medicinal waste by therapeutic category and these were included in the current analysis. The remaining three studies reporting the medicinal waste individually, by generic or brand name were excluded from the analysis of reporting the medicinal waste by therapeutic categorisation (Appendix 2).

The therapeutic categorisation systems used were not the same in all studies. Seven studies used British National Formulary (BNF) categories (Langley et al., 2005; Al-Siyabi and Al-Riyami, 2007; Mackridge and Marriott, 2007; Bradley, 2009; Trueman et al., 2010; El-Hamamsy, 2011; and Ibrahim et al., 2012). Five studies used the Anatomical Therapeutic Chemical Coding (ATC) of the World Health Organisation (WHO) (Abahussain et al., 2006; Coma et al., 2008; James et al., 2009; Abushanab et al., 2013; Vogler et al., 2014). Other ways of therapeutic categorisation included national coding such as the Saudi National Formulary (SNF) (Abou-Auda, 2003), Monthly Index of Medical Specialities online (MIMS) (Wongpoowarak et al., 2004). The remaining studies used disease and class of medicine classification such as diabetes/anti-diabetic. As a result, the returned medicinal waste were classified using many different therapeutic categories such as cardiovascular system (CVS), central nervous system (CNS), alimentary tract/gastrointestinal tract (GIT), respiratory system, musculoskeletal system and joint disease, analgesics and antipyretics, non-steroidal anti-inflammatory drugs (NSAIDs), endocrine system, malignant disease and anticancer medicines, nutrition and blood, vitamins and minerals gynaecology and medicines for urinary tract infection (UTI), antibiotics, medicine for Ear, Nose, and Oropharynx and skin medicine.

Eight studies out of the 28 (29%) reported that cardiovascular system (CVS) medicines were the most common therapeutic category of returned medicinal waste (Langley et al., 2005; Al-Siyabi and Al-Riyami, 2007; Mackridge and Marriott, 2007; Bradley, 2009; Guirguis, 2010; Trueman et al., 2010; Ibrahim et al., 2012; and Vogler et al., 2014). Central nervous system (CNS) medicines was reported in four studies out of the 28 (14%) as the most common therapeutic category of returned medicinal waste (Braund et al., 2008; Braund et al., 2009; James et al., 2009; and Al-Azzam et al., 2012). Other therapeutic categories of returned medicinal waste were also reported to be the most common therapeutic class but in less number of studies.

The different therapeutic categorisation systems used in reporting medicinal waste make the interpretation of results difficult. For example, one study from India combined analgesics with NSAID in one therapeutic category, while three studies from USA, Mexico and Thailand described analgesics and antipyretics as one category, and musculoskeletal and joint disease medicine as another category. In addition, the number of studies that investigated medicinal waste by therapeutic categorisation was reported more from some countries compared to others. For example, 8 studies out of twenty eight (29%) were reported from two countries UK (4 studies) and New Zealand (4 studies). This makes reporting of the results by the number of studies less representative worldwide.

In order to smoothly report the results from this structured review, firstly, all the different therapeutic categories were re-classified according to the *BNF categorisation* system and reported by *country* (Figure 2.6). For example, NSAIDs were re-classified under musculoskeletal system medicines (BNF Chapter 10), analgesic and antipyretics were re-classified under CNS medicines (BNF Chapter 4), and alimentary tract system medicines

were re-classified under gastrointestinal system medicines (BNF Chapter 1). Secondly, in countries where more than one report was found such as UK, New Zealand, Jordan, and Egypt, the sum of all returns of medicinal waste were calculated and reported by country.

Figure 2.6 shows the results of the common therapeutic categories of the returned medicinal waste reported by country, and after *re-classification* according to the BNF categorisation system. In the UK, results showed that CVS medicines were the most common therapeutic class of medicinal waste. A possible explanation is that CVS medicines is one of the commonly prescribed medicines comprising approximately 20% of all the medicines prescribed in the UK because of the prevalence of cardiovascular disease in the UK. Moreover, CVS medicines are one of the commonly amended classes of medicine because of frequent changes in the doses and drugs necessitated by updated guidelines (Langley et al., 2005). CNS medicines were the second most common therapeutic class of the medicinal waste in the UK. Other therapeutic categories of medicinal waste such as gastro intestinal and respiratory medicines were also reported but less commonly in the UK. Similar results to the UK were reported from countries such as Australia, Austria, Mexico, and Oman in which CVS medicines were the most common therapeutic class of medicinal waste. Moreover, in Mexico, Australia and Austria, musculoskeletal system medicines were also common and came in second place.

In New Zealand, results showed that CNS medicines were the most common therapeutic class of medicinal waste. The reason behind having CNS medicines the commonest medicinal waste is that paracetamol was the most common individual returned item as waste. Other therapeutic categories of medicinal waste such as gastrointestinal, cardiovascular and musculoskeletal system medicines were reported in New Zealand but

less commonly. In Jordan, results were similar to New Zealand, in which CNS medicines were the most common therapeutic class of medicinal waste and paracetamol was the most common individual tablet returned as waste (Braund et al., 2007). The reason of having CNS medicines as the commonest category of medicinal waste in Jordan is that analgesics are commonly used as self-medication for headache which is a generally common discomfort in Jordan (Al-Azzam et al., 2012). Other therapeutic categories of medicinal waste such as gastrointestinal, anti-infective, musculoskeletal system medicines were reported in Jordan but less commonly.

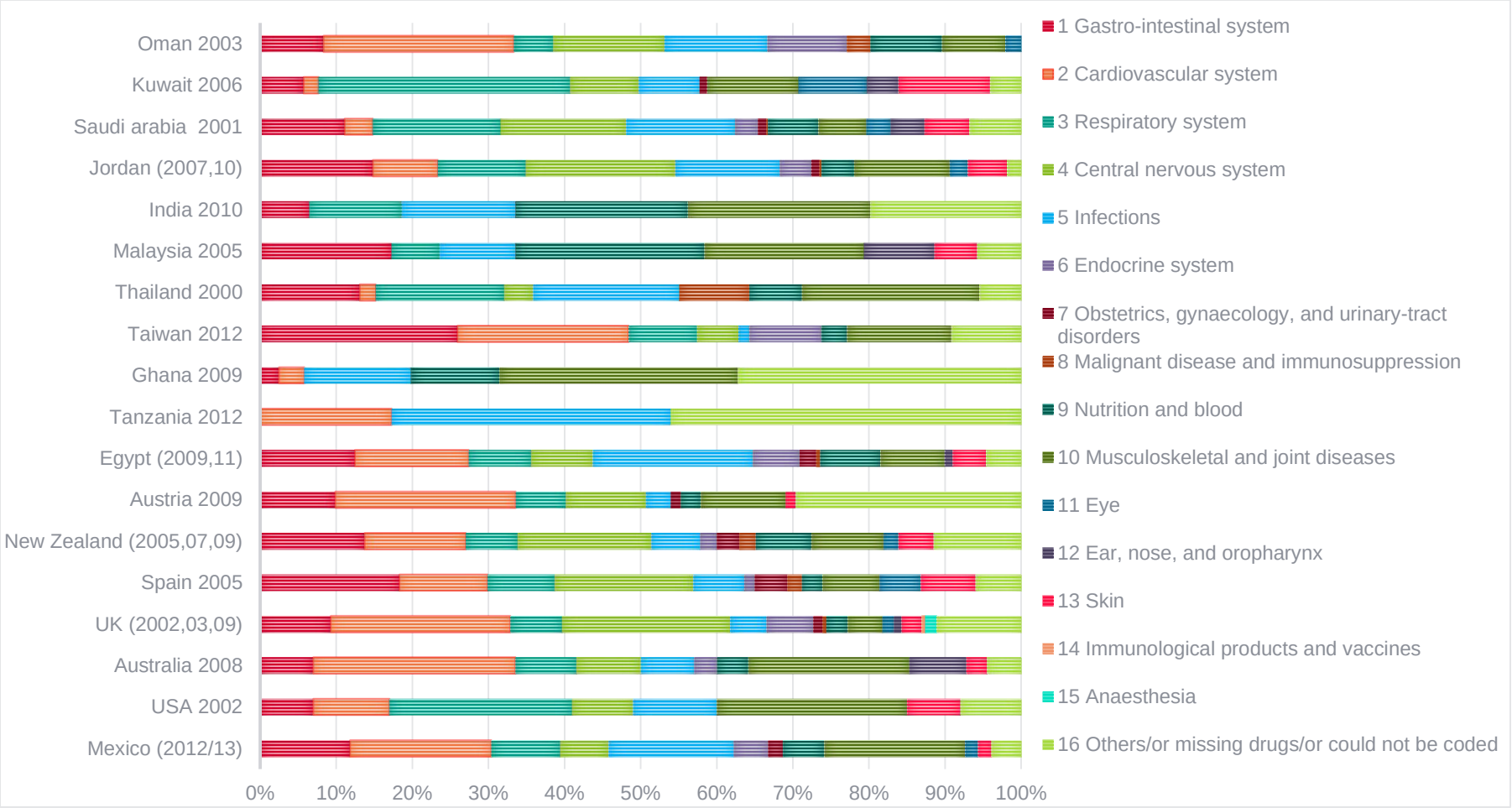
In Spain, results showed that both gastrointestinal system (215 items, 18.3%) and CNS medicines (214 items, 18.2 %) were the most common therapeutic classes of medicinal waste. While in Saudi Arabia, results showed that both respiratory system (16.8%) and CNS medicines (16.4%) were the most common therapeutic classes of medicinal waste.

In Egypt, anti-infective medicines were the most common therapeutic class of medicinal waste. The reason for antibiotics to be a commonly reported medicinal waste in Egypt was explained as antibiotics are available without prescription and also not completing the course of antibiotic treatment as symptoms resolve. Other therapeutic categories of medicinal waste such as CVS, and gastrointestinal system medicines were reported in Egypt but less commonly. Similar result to Egypt came from Tanzania, in which anti-infective medicines were the most common therapeutic class of medicinal waste. Other therapeutic categories of medicinal waste such as CVS medicines were in Tanzania but less commonly.

Results from USA, Thailand, and India showed that musculoskeletal system medicines were the most common therapeutic class of medicinal waste. The reason is that NSAID was the most common group of the medicinal waste reported in these countries.

Finally, result from Malaysia showed that vitamins and minerals were reported as the most common therapeutic category of medicinal waste. In this study, all participants were *females*. This could be the possible reason as females may use vitamins and minerals more than males.

**Figure 2.6 The common therapeutic categories of medicinal waste reported from different countries in the world, *re-classified* according to BNF categorisation system.**



### 2.8.4 Discussion

Despite extensive literature on medicinal waste, none of the literature reviews to date have specifically focussed on the therapeutic classes and the dosage forms of the returned medicinal waste. This structured review provides good insight on the different therapeutic categories and dosage forms of the returned medicinal waste from different countries around the world. The principal finding was that CVS medicines were reported as the commonest returned medicinal waste, certainly in the UK. It could be argued that the therapeutic category of medicinal waste could be as important as the quantity of the returned medicinal waste in terms of financial value. To clarify more, in the study by Braund et al. (2009), the volume of medicinal waste from respiratory system medicines were about the half (8%) of the medicinal waste of the CNS medicines (19%), but the cost of the medicinal waste in the respiratory group was 20% compared to 17% in the CNS medicines. This illustrates the financial implications of knowing the therapeutic categorisation of medicinal waste.

This structured review reported the results of the commonly returned medicinal waste from different countries around the world. However, these results should be interrupted carefully. Firstly, findings are applicable to medicinal waste that were returned by patients only and not taking into consideration that the majority of medicinal waste were reported to be disposed of into household garbage or via the sink or stockpiled at home (James et al., 2009). Secondly, the small sample size and the small number of returns of medicinal waste in about one third of the studies made these studies less representative. Finally, results from this structured review cannot be generalised. For example, results from Egypt and Tanzania of having antibiotics as the most common therapeutic category of medicinal waste cannot

be generalised to other countries where antibiotics are only available under a prescription such as UK or USA. Moreover, results from the Malaysian study which reported that vitamins and minerals were the most common therapeutic category of medicinal waste is impossible to generalize to the whole population as this was among only female Malaysian students.

This structured review has some other limitations which should also be acknowledged. Firstly, it included results from reports, thesis, audit, and grey literature (British library, and open grey), and there is a risk that some studies were not included as a result of not performing a systematic review. Secondly, the search strategy was restricted to studies that were published in the English language only. Thirdly, the reasons behind accumulation of the returned medicinal waste from each therapeutic category were not clearly evidenced. Some studies provided possible explanations that may be applicable only to the country from which data was obtained, and it may not be applicable to generalise these explanations. Finally, information about what motivates people to return their medicinal waste and if they returned certain type of medicinal waste over others were not investigated and remain unknown.

### 2.8.5 Conclusion

This structured review identified a limited number of studies from the literature which investigated the different therapeutic classes and the dosage forms of medicinal waste that were returned by patient to the CPs. Although there was variability between the levels of medicinal waste reported in different countries, findings from the UK were relatively consistent. In the UK, *cardiovascular medicines* were the category of the *returned* medicine most associated with waste. People's behaviour and the factors that could

determine people's decisions to return their medicinal waste or stockpiled them at home or disposed of them into the landfill or water system were not investigated. In addition, no formal research study has examined the general public's views about medicines reuse and whether they are willing to reuse medicines returned to CPs in the future. This review could provide the basis for a feasibility study investigating tablets prescribed for cardiovascular conditions as candidates for medicines reuse which could be the initial step for implementing medicines reuse before it is extended to other therapeutic categories of medicine in the future. But before such a study could even be planned, there is also a gap in the literature in that there are no qualitative studies that have investigated people's beliefs about medicines reuse and whether they would even consider reusing medicines in the future.

## 2.9 Gap in research about medicines reuse

Medicine reuse remain largely unexplored because unused medicines are not currently allowed to be re-dispensed to another patient in the UK, instead, medicines returned to a pharmacy are automatically considered to be waste that requires appropriate disposal. The main reason is that stability and safety of medicines cannot be ensured once medicines leave the formal distribution chain (i.e. are given out to patients). There is an opportunity to check some elements relating to the safety and stability of returned unused medicines using a unique identifier (a 2-dimension barcode) and an anti-tampering device which are yet to be introduced but on the horizon. The European Commission agreed in 2016 these two safety features are to be placed on the packaging of most human medicines to prevent the entry of falsified medication into the supply chain (European Medicines Agency, 2016). In the UK, manufacturers will be required to place the safety features on the packaging of

most prescription medicines and certain non-prescription medicines no later than 9 February 2019 (European Medicines Agency, 2016). The two safety measures can potentially be used to evaluate if any returned unused medicines can be suitable to be reused by checking their authenticity.

As stated previously, the implementation of medicines reuse in the UK would rely heavily on guaranteeing the safety and stability of the returned medicines, people's uptake of this idea, and pharmacist's views (time and agreement) about the possibility of implementing medicines reuse in the future. Moreover, the pharmaceutical company involvement would also be needed. This is because there are other features that might need to be investigated and added to product packaging in order to help verify the physico-chemical integrity of unused returned medicines. For example, it is possible to add a label that is sensitive to temperature which can indicate the storage temperature under which the medication has been kept while in the patient's charge. Pharmaceutical companies may also need to be involved in repackaging any returned unused medicines. To move toward medicines reuse in the UK, areas that need to be explored are people's and pharmacist's views about medicines reuse, and whether and how the pharmaceutical industry can contribute to guaranteeing storage conditions and/or repacking the returned unused medicines.

There has been little work carried out previously at examining perceptions about medicines reuse in the UK, apart from a study that examined whether pharmacists from one Health Board in South East Wales could come to some consensus on the barriers and potential solutions towards medicines reuse (McRae et al., 2016b). The results showed that pharmacists would be willing to redistribute medicines if certain criteria were met such as

being solid dosage forms with a tamper evident seal. The public's views about medicines reuse have not been investigated in the UK and this provided the basis for the current work.

To date, no formal research study has examined the general public's views about and their openness to the idea of medicines reuse. It is important to develop an understanding of what the public thinks about medicines reuse if the idea is to be pursued in the future. This thesis sets out to capture people's views about reusing medicines in the future using a psychological theory as its framework. The work in this thesis uses the Theory of Planned behaviour (TPB) as its psychological framework to address the feasibility of medicines reuse from the perspective of the general public. The next chapter explains the rationale for underpinning this work using a psychological theory and it details TPB as well as its application in the study of medicines waste and other environmental activities.

# CHAPTER 3 OVERVIEW OF PSYCHOLOGICAL THEORIES RELEVANT TO UNDERSTANDING PEOPLE'S BELIEFS AND INTENTIONS TOWARD REUSING MEDICINES

## 3.1 Introduction

There are several factors that can influence people's beliefs toward and intentions for conducting any behaviour such as reusing medicines. These factors can include potential advantages and disadvantages of performing the behaviour (i.e. medicines reuse), but also views about the safety and storage conditions of the retuned unused medicines, and a social pressure or normative belief about the behaviour. However, understanding these factors and the approaches that potentially can change people's intentions to reuse medicines is not straightforward. Psychological theory can be applied to help underpin the understanding of these factors. Such an approach provides a structured framework that can be used to formally design a questionnaire to capture people's beliefs and intentions toward reusing medicines. More importantly, it can be used in order to understand which elements of belief would need to be modified (e.g. through an intervention) before the behaviour takes place.

## 3.2 Psychological theories to understand people's beliefs and intentions

Human behaviour, how it is defined and the methods by which it might be studied, depends on the disciplines and interests of the researchers, with one discipline being psychology (Morris et al., 2012). Psychological theory can provide a generalizable organising framework for studying health-related behaviour (Michie et al., 2005). This is because as well as providing a means through which behaviour can be understood, health psychology theories provide a mechanism for influencing and changing people's behaviour.

Thus the application of a framework to study people's cognitive and behavioural responses to health-related issues could enable researchers and others to predict people's health behaviours, and in turn, attempt to change them (Godin et al., 2008). This will be detailed later in this chapter. However, in the meantime, there are many different and overlapping psychological theories and models available in the literature that can be applied or have been already applied to study health-related behaviours which are important to review and consider (Armitage and Conner, 2001; Taylor et al., 2006; and Ogden, 2012). In addition, lack of guidance on how to choose the most suitable theory for a particular research interest makes the selection of the relevant theory not straightforward (Michie et al., 2005; and Michie, 2008). One potential approach to improve the selection of a theory across relevant disciplines is to consider those psychological theories that could be of a potential use in informing public health questions, and then to narrow down the range of these theories to a specific health domain or topic. The identification of the range of theories could help select a relevant theory that can address the particular behaviour, population and context of the research question (Davis et al., 2015).

There are many psychological theories and models attempting to explain the relationship between people's thoughts, beliefs, decisions and behaviours, however, not all are helpful or in fact evidenced based (Donyai, 2012). The next section provides an overview of a number of health related social cognitive theories that are commonly and more frequently used (Armitage and Conner, 2000; Taylor et al., 2006; and Ogden, 2012). These include; the Health Belief model (HBM), Protection Motivation Theory (PMT), Trans-Theoretical Model of Health Behaviour Change (TTM/SoC), Theory of Reasoned Action (TRA), and Theory of Planned Behaviour (TPB). The purpose is to review these theories and outline a

rationale for the theory that was selected for this thesis. Note that although the majority of the theories outlined below focus on behaviours that relate directly to health, e.g. smoking cessation, there is precedence of applying these theories to other behaviours such as those relating to the environment and waste reduction. The main focus of the next sections therefore is to outline the theories but then argue for the external validity of the TPB to this study.

## 3.3 Overview of common health related social cognitive theories

### 3.3.1 Health Belief Model (HBM)

The Health Belief Model (HBM) is one of the earliest health models developed by a group of psychologist in the 1950s who attempted to predict the preventive health behaviours and the behavioural response to treatment in acutely and chronically ill patients (Rosenstock, 1974). Over recent years, the HBM has been used to improve many health-related interventions by predicting a wide variety of health-related behaviours (Carpenter, 2010; Ogden, 2012). Although the current thesis does not focus on a particular health condition or a behaviour that can directly impact on health, nonetheless this theory is reviewed because of its prevalence in health psychology research. The core beliefs of HBM constructs consist of; *perceived susceptibility* including a person's perception regarding risk of health behaviour (e.g. susceptibility to illness); *perceived severity* of the threat to health behaviour (e.g. severity of the illness); *perceived benefits* from the behaviour (e.g. stopping smoking will save money and reduce my illness); *perceived barriers* towards behaviour or the costs involved in performing the behaviour (e.g. stopping smoking will make me irritable); *cues to actions* which might be internal (e.g. family member illness) or external (e.g. television news and reports); and *demographics and socio-economic values* (e.g. age, ethnicity,

education and income) (Taylor et al., 2006; Ogden, 2012). Each of the individual constructs or when combined together can be used to predict the likelihood that the behaviour will occur.

The HBM has received many criticisms. Firstly, HBM has a weak predictive power in most areas of health-related behaviour (Armitage and Conner, 2000; Taylor et al., 2006). This is mainly related to the factors such as poor construct definition, and lack of other core psychological factors including environmental or economic issues that might also have an impact on clinical practice behaviours (Armitage and Conner, 2000; Taylor et al., 2006). In addition, variables such as intentions to carry out a specific behaviour, and the influence of social pressure, that can be highly predictive of behaviour are both neglected from HBM (Conner, 2010). Secondly, HBM does not have clear guidelines regarding how variables might be combined and operationalised, especially the constructs of benefits and barriers (Armitage and Conner, 2000). Although there is a lot of conflict in the literature around the use of HBM, studies have used this model or different aspects of the model's constructs to predict health related behaviours such as taking part in screening for hypertension, screening for cervical cancer, genetic screening, exercise behaviour, decreased alcohol use, changes in diet and smoking cessation (Taylor et al., 2006; Ogden, 2012).

### 3.3.2 Protection Motivation Theory (PMT)

The Protection Motivation Theory (PMT) is considered a revised version and expansion to HBM which includes additional constructs. According to PMT, the main determinant to carry out a health-related behaviour is protection motivation or intention to perform the behaviour, and the behaviour change may be achieved by engaging with an individual's fears (Munro et al., 2007). Protection motivation is determined by *threat appraisal* and the

*coping appraisal process*. *Threat appraisal* is referred to as a cognitive process the individual uses to assess the level of threat (including severity, susceptibility, and fear), while *coping appraisal process* refers to the individual's assessment of their ability to carry out risk preventive behaviour which influences the protection motivation (including response effectiveness and self-efficacy) (Janmaimool, 2017). Together, the outcome of the appraisal processes is classified into either adaptive (adopting of health behaviour) or maladaptive responses (avoidance or denial of health threat) (Conner, 2010; Ogden, 2012).

The PMT has been successfully applied to predict a number of health behaviours and is less widely criticised compared to HBM (Norman et al., 2005). However, a lot of HBM criticism could still be applied to PMT. For example, PMT generally considers that individuals are a rational information processor (except fear constructs which does include an element of irrationality). Moreover, PMT does not account for habitual behaviours (e.g. brushing teeth), and does not include a role for social (e.g. what others do) and environmental factors (e.g. opportunities to exercise or eat properly at work) (Ogden, 2012).

### 3.3.3 Trans-Theoretical Model of Behaviour Change or Stages of change (TTM/SoC)

The TTM/SoC is a more complicated model compared to TRA, and TPB (both described below), and HBM, and PMT (both described above) and the only one that was designed directly to potentially facilitate behavioural change (Taylor et al., 2006). TTM/SoC is a widely used cognitive model which divides individuals into five stages that demonstrate different levels of motivational willingness (to change their behaviour). These stages were first developed in relation to smoking and include; *pre-contemplation* (e.g. I am happy

being a smoker and intend to continue), *contemplation* (e.g. recently, I have been coughing a lot, maybe I should think about stopping smoking), *preparation* (I will buy fewer cigarettes), *action* (e.g. I have stopped smoking), and maintenance (e.g. I have stopped smoking for five months now) (Morris et al., 2012; Ogden, 2012). In some versions of the TTM/SoC, the final stage, *termination,* is added. In this stage the new behaviour is seen as being fully determined after a period of five or more years. (Taylor et al., 2006).

The transition between stages is controlled by self-efficacy and decisional balance constructs. Self-efficacy (which is also included in HBM and TPB) is expected to increase as individuals move toward action and maintenance stages. Decisional balance measures the individual's relative balancing of advantages and disadvantages of changes which combine to form a decision. This balance between advantages and disadvantages depends mainly on which stage of change the individual is in (Prochaska and Velicer, 1997). There are many criticisms regarding the complexity of the TTM/SoC model, how distinctive the stages are, and whether the individual should move through *each* stage. Moreover, changes between stages can occur so quickly which makes the stages less valuable (Ogden, 2012). Consequently, the TTM/SoC model is less clear on how individuals change or the reasons some change more efficiently than others (Morris et al., 2012).

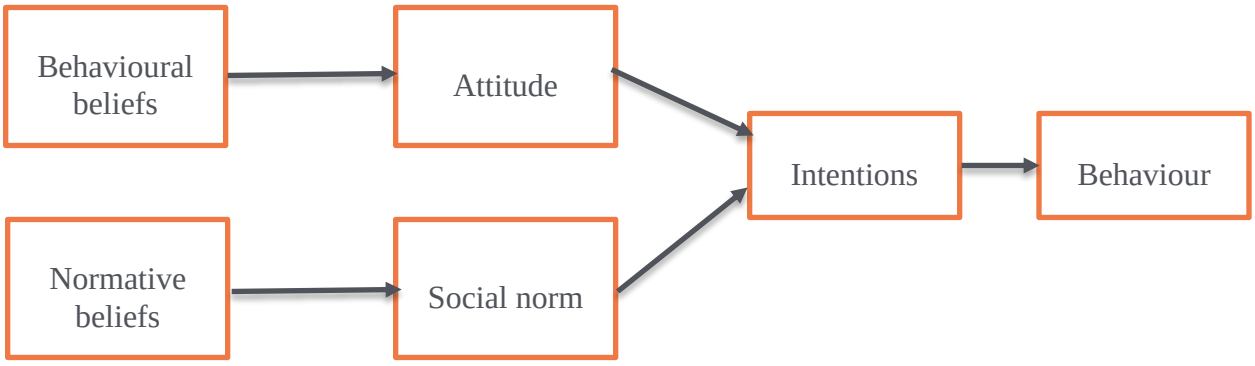
Another criticism of the TTM/SoC model is that the effectiveness of a stage based intervention differs based on the behaviour (West, 2005). Moreover, the fact that the stages in TTM/SoC are bound to a particular time interval is understood to be deceptive. As a result West (2005) proposed that a more coherent definition of the stages in TTM/SoC model is required. The criticism of TTM/SoC is mainly regarding the standardisation and

the consistency of the use of the TTM/SoC model which has also been raised recently by Friman et al. (2017).

### 3.3.4 Theory of reasoned action (TRA) and Theory of planned behaviour (TPB)

The TRA was developed by Fishbein and Ajzen in 1967 to examine the relationship between beliefs, attitudes, intentions and behaviour (Fisbein and Ajzen, 1975). The TRA assumes that individual's intention to perform a behaviour is the most proximal antecedent of that behaviour. Individuals' intentions are acknowledged by their attitudes toward performing the behaviour and the subjective norms relating to behavioural performance. Therefore, the TRA is an important model in which the individual is positioned within the social context (Ogden, 2012). TRA combines two sets of belief variables, the *behavioural attitudes* and *the subjective norm* as a requirement for individual's intention to perform a behaviour (Figure 3.1). The TRA was expanded by Icek Ajzen to develop TPB.

**Figure 3.1 Theory of Reasoned Action (TRA) model**

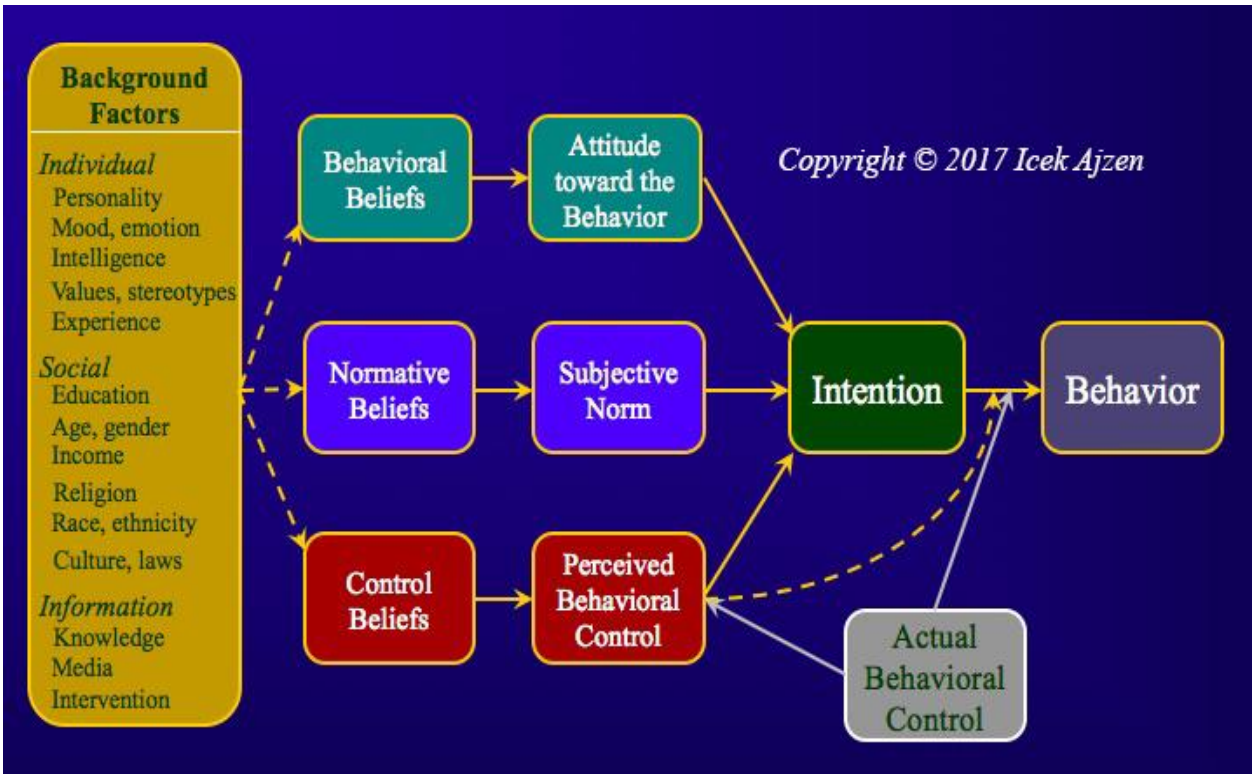



In TPB, Icek Ajzen attempted to evolve and extend TRA by adding the perceived behavioural control (PBC) construct. PBC is a construct describing the factors that control the individual's decision to carry out the behaviour. In addition, PBC is considered a representative for actual control, as it is expected to moderate the effect of intention on

behaviour (Ajzen, 2002). Intention to perform the behaviour is the key determinant of behaviour in TPB. Intention potentially is the best predictor of behaviour (Armitage and Conner, 2001). According to TPB, the stronger the intentions to engage in the behaviour, the more likely the behaviour will be performed (Ajzen, 1991).

The TPB proposes a framework in which cognitions (i.e. behavioural, normative, and control beliefs) and broader constructs (i.e., attitude toward the behaviour, subjective norm, perceived behavioural control, and intention) influence behaviour (Steinmetz et al., 2016) (Figure 3.2). The TPB proposes a framework to describe how human action is guided, suggests that intentions should be conceptualized as plans of action in pursuit of behavioural goals, and highlights behavioural intentions as an outcome of a combination of several beliefs, that is, the combination of attitude, subjective norms, and PBC (Francis et al., 2004; Ogden, 2012). To clarify this, if TPB is applied to alcohol use, then the TPB would make the following predictions: if a person believes that decreasing their alcohol intake would make their life better and would be useful to their health (i.e. attitude toward the behaviour) and believes that important people in their life would like them to decrease alcohol intake (i.e. subjective norm), and in addition believes that they have the ability of drinking less amount of alcohol due to their past behaviour and evaluation of internal and external factors (i.e. PBC), then this will predict high intention to decrease their alcohol intake. Moreover, the PBC can predict behaviour without the effect of intention. For instance and relating to exercise, if PBC reflects actual behaviour; a belief that a person would not be able to exercise, because they are physically not able to, would be a better predictor of their exercising than their high intention to exercise (Ogden, 2012).

**Figure 3.2 Theory of Planned Behaviour Model (TPB) with background factors (Ajzen, 2017)**




## 3.4 Assessment of the ability to use TPB to predict people's behavioural beliefs and their intentions to reuse medicines in the future

### 3.4.1 TPB compared to TRA, HBM, PMT, and TTM/SoC

TPB, TRA, HBM, PMT, TTM/SoC are special models that have in common a number of constructs that concentrate on individual behaviour and behaviour changes (Armitage and Conner, 2000; and Morris et al., 2012; Rosenstock, 1974). Although the majority of these constructs have originated from a common basis and share similar or overlapping characteristics, some of these constructs are unique to a particular theory and different from other theories (Armitage and Christian, 2003; Noar and Zimmerman, 2005; and Donyai, 2012). For example, the *perceived threat construct* of HBM described as perceived seriousness and perceived susceptibility is different from all other constructs in TRA, TPB,

and TTM/SoC. Moreover, the HBM includes objective demographics and cue to action construct that are not included in TRA, TPB, and TTM/SoC which can be seen as a potential advantage (Taylor et al., 2006). However, the evidence identified in practice in the review by Taylor et al. (2006) indicated that the HBM has not normally been used effectively to take advantage of having objective demographics and cue to action constructs as a potential strength (Taylor et al., 2006). The HBM is more health behaviour focused compared to TRA and the TPB, which are designed to be more applicable at greater levels of generalisation. Thus, TRA and the TPB can be applied outside as well as inside the health discipline (Ajzen, 2002).

The TRA and the TPB have in a common identical attitudinal and social norm constructs. In addition, the TPB contains a PBC construct relating to control related beliefs and self-efficacy (Ajzen, 2002). The TRA and the TPB have less, but more accurately defined constructs, and are mathematically better specified than the HBM and the TTM/SoC. This promotes the adequacy and consistency of the use of TRA and TPB (Taylor et al., 2006).

The TPB is more appropriate to predicting behaviour and has been widely used inside and outside health-related research (Armitage and Conner, 2001; Ajzen, 2002; Taylor et al., 2006; and Morris et al., 2012). There is meta-analytical and systematic review evidence that the predictive performance of both the TRA and the TPB is superior to that of the HBM. Moreover, the additional constructs contained in the TPB allow it to have a greater predictive percentage of overall behavioural variance than the TRA (Taylor et al., 2006). The available evidence in the review by Taylor et al. (2006) suggests that the application of TPB in countries like USA and UK can predict around 20-30% of observed variance of health behaviours. Moreover, there is a strong correlation between behaviour and both the

attitudes towards the behaviour and PBC constructs of TPB. However, the correlation between behaviour and subjective norms is less and sometimes referred to as a weak correlation (Morris et al., 2012). The issue of the weak correlation was argued by Armitage and Conner (2001) to be probably methodological as a small number of studies that measured subjective norms fairly reported strong relationships with behaviour (Morris et al., 2012).

### 3.4.2 Support for the application of TPB to predicts people's behaviour and intention towards reusing medicines

TPB is a framework which has been widely applied in a variety of domains for predicting and explaining behaviour, and increasingly for conducting behaviour change interventions (Ajzen, 1991; Perkins et al., 2007; and Steinmetz et al., 2016). There have been several reviews and meta-analyses which describe the *generalisability* of TPB use in different behavioural domains and its *effectiveness* to predict a range of health behaviours (Armitage and Conner, 2001; Taylor et al., 2006; and Ogden, 2012). The *generalisability* of TPB-based effective interventions is reviewed in the recent meta-analysis by Steinmetz et al. (2016) and summarised into eight behavioural domains; alcohol and drugs, adherence to medical regimens, hygiene, nutrition, physical activity, sexual behaviour, traffic, and work and school behaviour. These domains involved studies that were concerned with reducing alcohol consumption (Hagger et al., 2012; Armitage et al., 2014), smoking cessation (Bledsoe, 2006; Topa and Moriano, 2010), predicting adherence to medicines (Abraham et al., 1999; Chisholm et al., 2007), promoting hand hygiene (Yardley et al., 2011), nutrition related intervention such as promoting whole grain foods by dieticians (Chase et al., 2003) and food safety (Milton and Mullan, 2012), physical activity (Hagger et al., 2002) and weight control (Schifter and Ajzen, 1985; McConnon et al., 2012), sexual behaviour related

interventions such as promoting safer sex practices (Armitage and Talibudeen, 2010; Booth et al., 2014; and Asare, 2015), traffic related interventions such promoting school-age cyclists to wear safety helmets (Quine et al., 2001), and promoting driver's compliance with speed limits (Elliott and Armitage, 2009), and work related interventions such as promoting work health and safety (Sheeran and Silverman, 2003). In addition to the above domains, TPB-based interventions have been applied in other domains such as environment and sustainability (Stern, 2005; Koger and Winter, 2011; and De Leeuw et al., 2015), reuse (Sumaedi et al., 2016), recycling (Davis and Morgan, 2008; Pakpour et al., 2014) and intention to donate to charity (Van der Linden, 2011). These are examples of studies which applied TBP in different domains that reflect the *generalisability* of TBP.

The *effectiveness* of TPB-based interventions in predicting behavioural changes were reviewed in a number of studies and meta-analyses. For example, in the quantitative meta-analysis review of 185 independent studies published up to the end of 1997, Armitage and Conner (2001) found that across all behaviours, the average multiple correlation of intention and PBC was 0.52 with behaviour accounting for 27% of the variance, and the average multiple correlation of attitude, subjective norm and PBC with intention was 0.63 accounting for 39% of the variance. Moreover, when the behaviour measures were self-reports, the TPB accounted for 11% more of the overall variance than when the behaviour were externally observed. Finally, in the study by Armitage and Conner (2001), the correlation between subjective norms and behavioural intention was found to be weaker than those between attitudes and the behavioural intention and between PBC and behavioural intention.

Ajzen (1991), conducted a review of 16 studies involving the TPB to examine the effectiveness of TPB-based interventions in predicting behavioural changes and found that attitude, subjective norm and PBC accounted for a significant amount (20% to 78%) of variance in behavioural intention. The multiple correlations between behavioural intention and its three predictors (i.e. attitude, subjective norm and PBC) ranged from (0.43 to 0.94), with an average correlation of 0.71. Moreover, Ajzen (1991) added that PBC together with intention were significant predictors of behaviour, with the average multiple correlation being 0.51.

Finally, in a review by Godin and Kok (1996) of 56 studies, the variance in behavioural intention explained by TPB constructs was 40.9% and PBC was a significant predictor in 85.5% of health related studies, followed by attitude (81.5%) and subjective norm (74.4%). PBC contributed a mean additional 13% of variance to the prediction of behavioural intentions, over and above the attitude and subjective norm, and 12% to the prediction of behaviour. The PBC figures reported by Godin and Kok (1996) were higher than those reported by Armitage and Conner (2001). Subjective norm was a strong predictor of the behaviour in the study by Godin and Kok (1996) compared to the Armitage and Conner (2001) study, which was reported to be a weak predictor of the behaviour.

These reviews and meta-analyses support the empirical applicability and popularity of TPB, and demonstrated that TPB is quite a successful model in explaining and predicting behavioural intentions and actual behaviours. In this thesis, TPB is applied to understand people's beliefs and intentions to reuse medicines in the future.

## 3.5 Aims of the research

This thesis aimed to capture people's beliefs and intentions towards reusing medicines that are returned to pharmacies by using TPB as its underpinning framework. Medicine reuse relates to the idea that unused prescribed medicines returned by one patient to a pharmacy can be re-dispensed and therefore reused by another patient as a strategy for reducing medicinal waste in the UK. The objectives were first (i.e. phase one) to use interviews to define medicines reuse as a behaviour; and identify behavioural, normative, and control beliefs about medicines reuse. Then (i.e. phase two), to construct, validate, pilot and develop a questionnaire which captures representative views about medicines reuse in the UK and people's intentions and willingness to reuse medicine in the future. The final part of this thesis (i.e. phase three) focuses on overall conclusions, recommendations and explaining future work that can arise from the findings of this study.

## 3.6 Rationale of the research design

This is a mixed method study design using qualitative interviews to define the behaviour (i.e. medicine reuse), identify normative, behavioural, and control beliefs about the behaviour, and develop items of the indirect measures of TPB, and then use the developed Medicine Reuse Questionnaire (MRQ) to quantitatively capture people's beliefs and intentions to reuse medicine in the future. The mixed methods design of having a qualitative-quantitative approach was determined by the use of TPB which requires first performing the elicitation qualitative study, then applying the developed questionnaire (i.e. MRQ) quantitatively (Francis et al., 2004; and Ajzen, 2006).

During the qualitative study, the face to face interviews as a data collection method was chosen over a focus group approach. The reason behind choosing face to face interview is

that first TPB is about individual not group opinions, and second there was a risk of people leading each other during the focus groups which would affect the results of this research, for example by failing to capture the breadth of possible themes (Ajzen, 1991; Ajzen, 2011; and Ajzen, 2017). In addition, the decision to apply thematic analysis (TA) was influenced by simplicity and theoretical freedom of TA and its ability to provide rich and detailed themes. In addition, TA allow for the application of inductive, deductive and mixed inductive-deductive approach (Braun and Clarke, 2006). Other options were not used either because of complexity of having many different types that were again not directly relevant to this work (e.g. light and full grounded theory) or not being applicable to this study (e.g. discourse analysis) (Goulding, 2017). Finally, the semi-structured face to face interview was chosen as a data collection method over full in-depth unstructured interview first because of the use of TPB which requires a deductive approach of mapping themes against pre-existing concepts, and secondly, because the purpose of this study was to develop and construct the MRQ, necessitating a structured approach.

There are many psychological theories and models attempting to explain the relationship between people's thoughts, beliefs behaviours, however, not all are helpful (i.e. some have been criticised in terms of effectiveness and their predictive power, and less clear construct development and unclear guidelines about the how to measure the behaviour or the intention toward the behaviour compared to TPB) or in fact some are thought not to be evidenced based. The Health Belief model (HBM), Protection Motivation Theory (PMT), Trans-Theoretical Model of Health Behaviour Change (TTM/SoC), Theory of Reasoned Action (TRA), and Theory of Planned Behaviour (TPB) were reviewed in this chapter and the effectiveness and superiority of the TPB over other theories was clearly illustrated. To summarise more, TPB has

more accurately defined constructs, and is mathematically better specified than the HBM and the TTM/SoC. In addition, TPB is more appropriate to predicting behaviour (i.e. the effectiveness and predictive power) and has been widely used inside and outside health-related research (i.e. the generalisability of TPB include application to; alcohol and drugs, adherence to medical regimens, hygiene, nutrition, physical activity, sexual behaviour, traffic, and work and school behaviour). Finally TPB has unique concepts which can predict performing the behaviour (i.e. people are able to perform the behaviour or not) without the need to know their intention. This is important, for example people may intend to do exercises (i.e. intention construct) but actually not perform the behaviour (i.e. exercise), simply because they are not able physically to do exercise while actually intending to do so (i.e. PBC).

## 3.7 Steps applied to manage the development of a TPB Medication Reuse Questionnaire (MRQ) and thesis outline

### 3.7.1 Defining the behaviour of interest and selecting the population

When TPB as a psychological framework was applied, certain steps were followed to enhance the validity of the research. These steps were according to recommendations made by Ajzen (2006) and Francis et al. (2010). First, a formal definition of the behaviour under investigation was defined. The TACT principle was used, by which the behaviour was defined according to target, action, context, and time. For example, for the behaviour "capturing people's beliefs and intention to reuse medication that are returned to pharmacies by another patient" the target is people, the action is to capture people's beliefs and intentions to reuse medication, the context is reusing medication that are returned to pharmacies by another patient, and the time is in the future. A sample of population of

interest for an elicitation (qualitative study) study was determined. The sample size for the elicitation study was aimed to be between 15−20 participants.

### 3.7.2 Completing the elicitation Study

An elicitation study was used to develop the indirect measures (behavioural beliefs, normative beliefs, and control beliefs) for all the predictor constructs of TPB (attitude, subjective norms, and PBC). A sample of 19 participants was interviewed face to face and the data were analysed using thematic analysis. Themes obtained from the elicitation study were classified according to the TPB constructs (Chapter 3) and were used to develop the questions related to the indirect measures of the TPB.

### 3.7.3 Developing the Medication Reuse Questionnaire (MRQ)

The MRQ questions were of three types; first the questions developed from the elicitation study which were related to the indirect measures of TPB, second, the question related to the direct measures of TPB, and third, the questions related to the background factors that are important and related to medicines reuse. All the MRQ questions were developed according to Ajzen (2006); and Francis et al. (2004) guidelines.

### 3.7.4 Piloting and validation of the MRQ

The participants of the elicitation study were re-invited for a face to face interview to review and comment on the items of the draft MRQ. Content validity was applied by asking cognitive questions (Chapter 4) and also some general questions at the end of the interview such as are any items difficult to answer or ambiguous; does the questionnaire feel too repetitive; does it feel too long; does it feel superficial; and are there any annoying features of the wording or formatting?

Reliability testing was applied including internal consistency for the direct measures of TPB and test-retest reliability for the indirect measures of the TPB. Finally, Confirmatory Factory Analysis (CFA) was applied to the MRQ (Chapter 4) to confirm that the questions measuring each construct are considered indicators of the same latent variable; and the TPB model in which the attitude, subjective norm, PBC, and intention items are treated as assessing separate constructs is superior to a model in which all questions are considered to measure the same underlying construct (Ajzen, 2017).

### 3.7.5 The use of the MRQ

Following the elicitation study (Chapter 3), MRQ items was created, reviewed and underwent validity and reliability test (Chapter 4). The MRQ was then developed and made available online using the Qualtrics online platform. An online panel was used to recruit participants in collaboration with a market research panel company called Research Now®. The MRQ was used to capture the representative views about people's beliefs and willingness to reuse medicine in the future. These data were used in order to report on the beliefs and also to illustrate the predictive properties of the different elements of the MRQ (Chapter 5).

### 3.7.6 Overall conclusions, recommendations and future work

Having developed and used the MRQ and reported on the findings, the final element of this thesis (Chapter 6) reflects on the findings and produces recommendations for extending this work into the future.

# CHAPTER 4 IDENTIFYING BELIEFS ABOUT MEDICATION REUSE: QUALITATIVE ELICITATION STUDY

## 4.1 Introduction

As outlined in the introduction to this thesis, in the UK unused prescribed medicines are treated as waste and should be returned to a pharmacy for disposal but people are more likely to dispose of their medicines inappropriately than return them to pharmacies. A sustainable system for addressing medicinal waste is needed. One solution in theory is to reuse certain returned prescribed medicines but this is not currently permitted in the UK and people's beliefs about medicines reuse remain unexplored. In this chapter, the aim was to capture people's beliefs about medicines reuse and to map the determinants of people's intentions to take part in medicines reuse behaviour. The research question was 'what are the behavioural determinants of medicines reuse?' The objectives were to define medicines reuse as a behaviour and identify beliefs about this behaviour using qualitative interviews and the Theory of Planned Behaviour (TPB) (Francis et al., 2004; Ajzen, 2006).

Thematic analysis (TA) of the interviews was carried out because it provides a way of organising qualitative interview data in the form of themes: recurrent topics, ideas or statements identified across the corpus of data. However, TA also received a lot of criticisms in past based on the absence of clear and precise guidelines on how researchers analysing their data (Braun and Clarke, 2006). In order to avoid this, and to have a clear demarcated TA, a step by step approach as described by Braun and Clarke (2006), was followed using a series of six phases of analysing the data. TA is judged to be highly suitable approach to this research because of its theoretical freedom which means it is

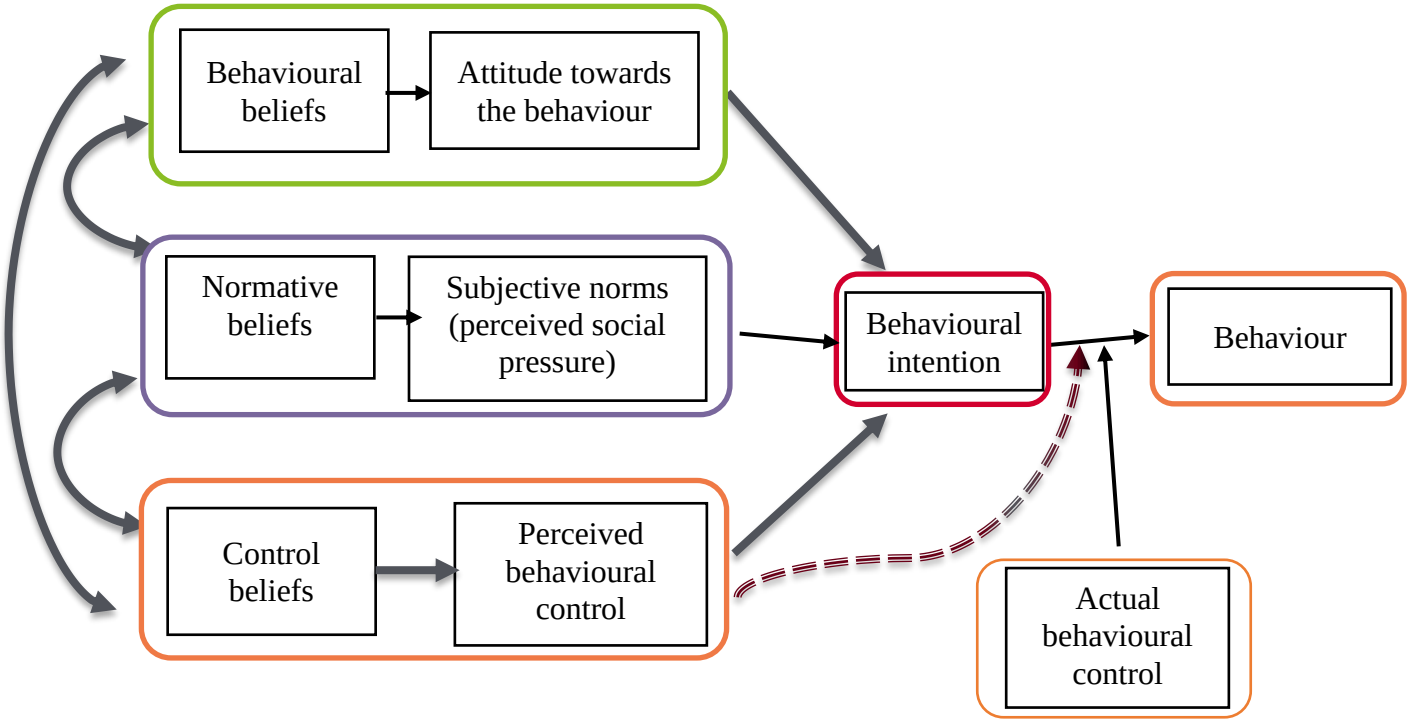
flexible and useful in providing rich, detailed and complex data. Moreover, its flexibility also allows inductive, deductive, and mixed inductive-deductive approach.

In this chapter, a mixed inductive-deductive approach was used. Themes obtained inductively using TA were mapped against a theoretical framework (i.e. TPB was used to identify themes) within a deductive approach (Braun and Clarke, 2006). That is, the identification of themes in was guided by the theoretical framework of the TPB. The ontology that underpins thematic analysis values humans as 'sense making' individuals who can reflect on their experiences and produce meanings through the use of language.

The TPB makes a distinction between behaviour and behavioural intentions on the basis that what people intend to do is more predictable than what they will actually do (Ajzen, 2006). This is particularly pertinent to this research since medicines reuse in the UK is not yet a reality According to TPB, behavioural intentions are a function of three determinants: firstly, the person's attitude in terms of likely consequences of the behaviour (behavioural beliefs), that is the individual's positive or negative evaluation of taking part in the behaviour, creating a favourable or unfavourable attitude towards the behaviour; secondly, the person's beliefs about the normative expectations of other people (normative beliefs), that is social pressure to take part or not take part in the particular behaviour, creating a perceived social pressure or subjective norm; thirdly, the individual's beliefs about the existence of factors that may enable or obstruct taking part in the behaviour (control beliefs), that is whether the person has control over the behaviour, creating a belief about perceived behavioural control. The combination of these three factors leads to the formation of an individual's behavioural intention, which is thought to be the immediate antecedent of the behaviour according to the TPB. With a sufficient degree of actual

control over the behaviour, the model expects that people would carry out their intentions when the opportunity arises (Figure 3.1).

**Figure 4.1 Schematic representation of the theory of planned behaviour, adapted from Ajzen (2006), showing the relationship between the determinants of behaviour (copyright ©2006 Icek Ajzen).**




The findings of this chapter were accepted to be published on 20th June 2017, in the International Journal of Pharmacy Practice (IJPP) under the title "How do people conceptualise the reuse of medicines? An interview study".

This chapter (i.e. the qualitative elicitation study) is referred to as phase 1 of the larger study. In this phase people were recruited and interviewed using face to face semi-structured interviews to capture their beliefs about medicine reuse as a behaviour. This is discussed further in the next sections.

## 4.2 Aims and objectives

The aim of phase 1 of the study was to:

a) Define medicine reuse as a behaviour, identify themes, and categorising these themes to behavioural, normative, and control beliefs about medicine reuse.

The objective of phase 1 described in this chapter was to:

a) Use thematic analysis to capture themes relating to people's beliefs about medicines reuse, and then use the Theory of Planned Behaviour (TPB) as a tool to categorise these themes into behavioural, normative, and control beliefs about medicines reuse.

## 4.3 Methods

### 4.3.1 Compliance with ethical standards

This study was approved by the University of Reading's Research Ethics Committee through the School Exemptions process (reference number 30/15) on 6/5/2015 (Appendix 3). Information letters (Appendix 4) were sent to the participants who showed an interest to participate in this study and written consent (Appendix 5) from each participant was obtained before the interviews.

### 4.3.2 Setting and participants recruitment

Participants were recruited in spring 2016 through an advertisement placed in the university's community newsletter circulated biannually to local residents. The university's community newsletter is often used to recruit participants to research projects because it reaches 15,000 local households. The advert (Appendix 6) used for this study sought English-speaking adults with an interest in the concept of medicines reuse and willingness

to participate in a qualitative study by attending an interview at the university campus. Medicines reuse was defined as "the idea that medication returned by one patient can be dispensed by a pharmacist to another patient" (instead of disposal as waste – which is what currently takes place). Participants either contacted the research team directly or were introduced to the research team via already-recruited participants via email. A balanced number of men and women were interviewed, and there was also good representation across different age bands meaning that recruitment continued until data saturation using convenience sampling. Data saturation was guided by an initial desired sample size (n = 20) determined by PD and HA according to the TPB methodology (Ajzen, 2006) which was modified down when no additional themes were identified after interviewing the 15th participant (Francis et al., 2010). After this time point, four more people were interviewed but three additional people who contacted the research team expressing an interest were turned away.

### 4.3.3 Data collection

A semi-structured interview schedule (Appendix 7) based on the TPB and focussing on behavioural beliefs, normative beliefs and control beliefs in relation to medicines reuse was constructed and used in the interviews (Ajzen, 2006).

Fifteen participants were interviewed by both the PhD supervisor (PD) and (HA) (the PhD student) in attendance, after which the remaining four participants were interviewed by HA alone. Written consent was obtained, and the interviews, which lasted around 40 min, were audio-recorded. Participants were recruited until no more new and significant concepts emerged (i.e. sampling saturation).

### 4.3.4 Data analysis

Interviews were transcribed verbatim, password-protected and anonymised/de-identified by 'The Transcription Agency', a university-approved supplier. HA reviewed all transcripts to confirm that names or other information that might identify the participants had been removed, and also ensured data integrity by cross-checking the transcripts against the interview recordings, in consultation with PD. The interview transcripts were analysed manually, and then the NVivo 10 software (QSR International Pty Ltd. Version 10, 2012) was used to visualise theme connections and to construct the initial and then the final thematic maps. The thematic analysis process was carried out by HA according to the six phases described by Braun and Clarke (2006) and was reviewed by PD. The recordings were listened to several times to guarantee the precision of the transcription process and the transcribed data were read and re-read, before the primary ideas were noted down. This repeated process of reading is the primary phase of analysis which ensures familiarisation with the data and data immersion. Following the primary phase, coding was introduced. During the coding process, attention was distributed equally to the corpus of transcribed data to identify all of the interesting concepts, and the data were systemically organised into meaningful sets. These codes were then combined to form the wider unit of analysis called the theme or sub-theme. This third phase of analysis involves searching for themes and the analysis is refocused on broader level (theme level) coding and incorporating the different relevant codes into themes or potential themes (Appendix 8, summary of the thematic coding process and analysis). A thematic map was used to describe the relationship between the emerging themes and sub-themes as shown in the (Figure 4.2).

The fourth phase of analysis involved reviewing the themes. At this point refinement of themes occurred at two levels; level one included reviewing the coded data extracts by reading all the collated extracts against each theme to ensure a coherent pattern and to discard or rework themes that did not fit to the dataset. Reviewing the dataset at this stage also ensured that no data were missed at an earlier stage. The thematic map that emerged was then considered to be a precise reflection of the meaning evident in the entire dataset (Figure 4.3). Phase five of the analysis was about defining and labelling the themes and capturing the story within individual themes and how it fitted the overall story in the dataset. The sixth and the final phase of analysis consisted of producing the current manuscript and selecting examples of data extracts to explain elements of the themes and relating this back to the research question. Themes obtained from the process of thematic analysis were categorised according to the TPB to define behavioural beliefs, normative beliefs and control beliefs about the reuse of unused prescribed medicines.

**Figure 4.2 Initial thematic map, showing three themes (oval shapes) and their sub-themes**

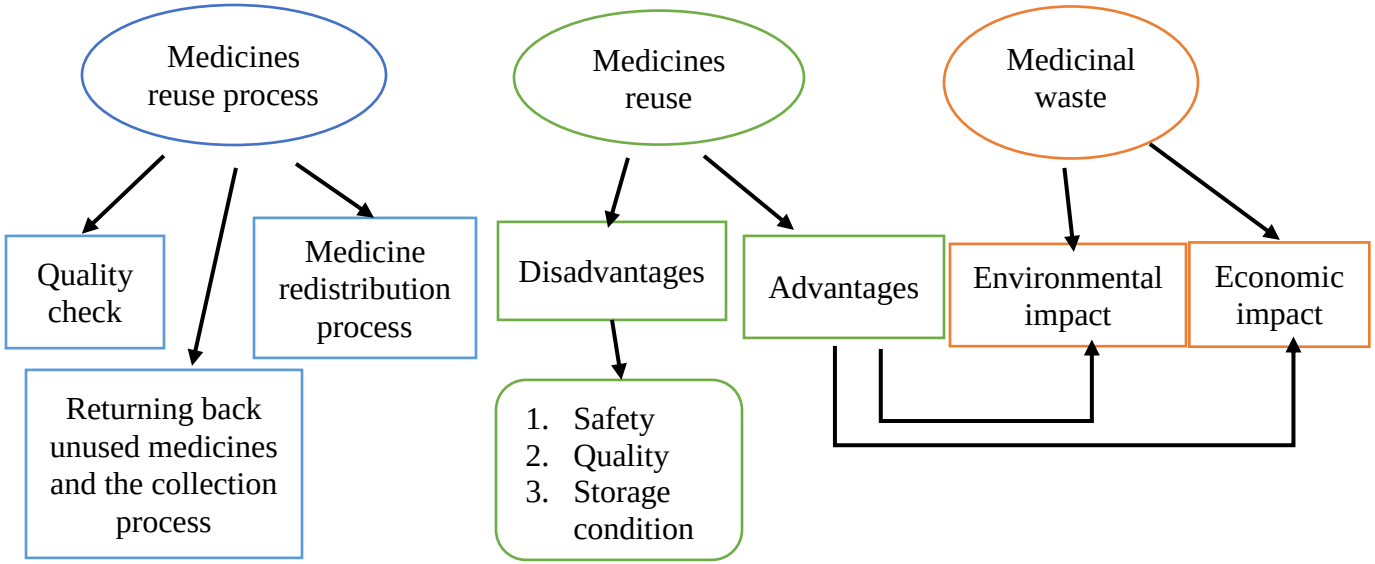
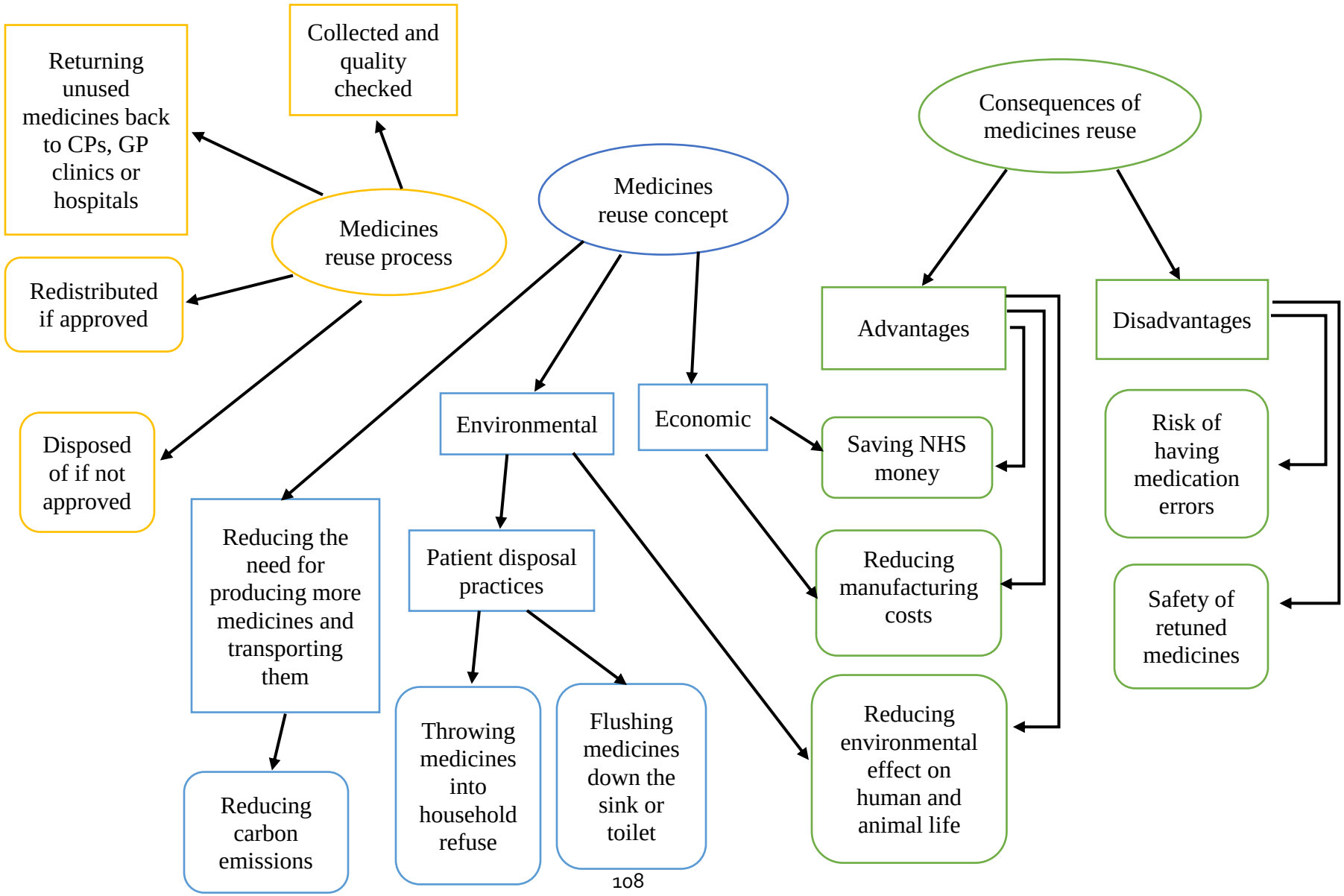


**Figure 4.3 Developed thematic map showing three major themes (oval shapes) and their sub-themes before the data were related to the TPB (abbreviations: Community Pharmacies (CPs); General Practitioner (GP))**



## 4.4 Results

From 22 participants who contacted the research team, a total of nineteen were recruited (11 female), including one couple who were interviewed jointly. Two participants were British Asian and 17 were white British. Participant age groups were 40-49 (n=3), 50-59 (n=2), 60-69 (n=8) and >70 (n=6).

Three major categories were identified and labelled: "Consequences of medicines reuse" (relating to behavioural beliefs), "Exemplar and anti-exemplar individuals and groups" (relating to normative beliefs), and "Expectations about returned medicines" (relating to control beliefs). The compositional structure of these categories is described in tables (3.1, 3.2, and 3.3).

Participants interviewed in this study were generally in favour of the idea of medicines reuse in that they felt the NHS should move to a system whereby unused prescribed medicines would be reused instead of being discarded. This system of reusing prescribed medicines would not be obligatory, with patients opting in or out, and the whole process regulated to prevent misuse. The following quotes illustrate this point:

> *"Medicine reuse should be regulated and monitored by NHS to avoid the risk of having black market, this include pharmacist selling the collected medicines online, and also counterfeit medicines that patient bought online should not put back the shelf (if returned) and this will be assured during a quality check by the pharmacist." (P17, female, >70 age group)*

> *"I think the majority of people because of the trust they have in the health service, if it was standard practice for the health service then they may well accept it. The*

*difficulty would be if you made it look as though it was a practice carried out by pharmacists, they might object. It would have to be seen to be something that's done by the health service, OK, rather than by the pharmacy, the pharmacy only acting as an agent for the health service." (P15, male, 50-59 age group)*

### 4.4.1 Consequences of medicines reuse

This category encapsulates participants' understanding of the advantages and disadvantages of medicines reuse if ever implemented (see Table 4.1).

#### *4.4.1.1 Potential advantages of medicines reuse*

Both economic and environmental advantages of reusing medicines were discussed. Some perceived that reusing unused medicines would save money for the NHS and reduce manufacturing costs by cutting medicinal waste. The following quotes exemplify this point:

*"Mainly I would say economy, because it does seem wasteful that these things cost a lot of money to research and develop and produce, then package and transport, then being wasted, so it is a question of economy." (P2, male, >70 age group).*

*"I would say the main advantage of reusing medicines is saving on cost, in this country masses of drugs are wasted. When you have been prescribed something and did not need much of it, and then you think what an awful waste? Surely it would be better to return it and somebody else able to use it." (P5, Male, 60-69 age group)*

*"I think medicine reuse would be an efficient thing to do financially and environmentally, because if you are reusing you are not having to produce as much, and also you are reducing waste." (P7, female, 60-69 age group)*

In addition, medicines reuse was thought more applicable for expensive medicines especially if logistical costs of reuse processes were to dwarf the monetary value of cheaper medicines; logistical costs were conceptualised in different ways. For example if medicines reuse processes could not happen in a pharmacy because of competing priorities or lack of storage space, a formal, costly system for collecting and despatching unused medicines to, say, a clinical centre might be needed; there technicians could work to check, repackage, and prepare the medicines for reuse, which would carry a cost. The following quote illustrates the former point:

> *"Generic medicines, maybe they are so cheap that a packet of aspirin cost maybe 16p or something, but maybe some of the more expensive medicines that is definitely worth reusing." (P3, male, 40-49 age group)*

Medicines reuse was thought to reduce the proportion of medicines thrown into household bins and encourage people to return unused medicines to a pharmacy, thus helping reduce negative environmental effects arising from medicines reaching landfill or the water supply. Some felt knowing returned medicines were destined for disposal under the current system acted as a disincentive for returning unused medicines to a pharmacy. For example:

> *"Most people just dispose of their medicines in the bin, and probably only a minority of people actually take the medicines back to the pharmacy. A lot of these medicines contain chemicals which probably make their way into the water and could pollute water supply. Oestrogen for example could make its way into the water supply. I don't know whether these chemicals break down within a period of*

*time and become inert, or whether they continue to be active and modify the environment." (P3, male, 40-49 age group)*

*"I do believe there's an enormous amount of medicine wasted, and sometimes I wonder what happens to these wasted medicines as it would be awful to wash it down the water works, all these drugs and chemicals would harm health in another sort of way. And I have always wondered why if they're intact they're not reused." (P11, female, 40-49 age group)*

*"People Flush medicines down the loo or just put it in the rubbish bin. Dreadful. When Hormones such as oral contraceptives flushed down the loo, it was linked to low sperm count in men" (P16, female, 40-49 age group).*

*"I think one of the reasons people put medicines down the loo is because they know if they take the medicine back to the pharmacist he is going to destroy them anyway so they think, why I should make the effort with this, pointless. They don't understand the damage they might be doing so I think there would be an environmental benefit." (P15, male, 50-59 age group)*

Medicines reuse was thought to reduce the overall carbon footprint of medicines by impacting on manufacturing and transport of new medicines. For example:

*"So what I'm describing I think are people who are more aware, shall I say, of a bigger picture, they're not thinking just personally, they're thinking what can I do, does it save the environment, if one less packet of pills has to be made that's one less*

*energy, that's less transport, it's all the good reasons, not just money." (P2, male, >70)*

#### *4.4.1.2 Potential disadvantages of medicines reuse*

Participants identified a range of issues with reusing medicines that had been in the hands of other people. The proper storage of unused medicines in terms of the temperature, humidity, or cleanliness of the storage environment was one concern. Linked to this was the impact on the safety of unused medicines. Safety was conceptualised as inadvertent contamination or deliberate tampering. For example:

> *"I think my concerns about medicine reuse would be the hygiene aspects of the returned medicine as I want to know if it was stored in a clean place, and that I wasn't going to get any kind of infection or problem with it." (P1, female, 60-69 age group)*

> *"I think the main issue of reusing medicines would be the risk. I suppose some medications have to be stored at certain temperatures, like insulin. Also you would have to be assured that the medicine had not been tampered with." (P4, female, 60-69 age group)*

> *"The thing that would concern me about reusing medicines is if the drugs had become contaminated somehow, so there would have to be a very thorough check to make sure something has not been contaminated in some way." (P5, male, 60-69 age group)*

In addition, the risk of medication errors was highlighted in terms of errors introduced by patients and the risk of returning counterfeit medicines. The risk of errors made by

pharmacists was also a concern such as redistributing the wrong medicine to a patient and accepting counterfeit medicines. For example:

> *"There could be a risk of medication error being made, for example if somebody put a medication back in the wrong box and returned it. There have to be very strict rules on checking the returned medicines." (P6, male, >70 age group)*

> *"I suppose there is a slight risk of a wrong drug getting into a wrong packet or being placed in the wrong place somewhere, so being mis-prescribed but I think it is quite small because pharmacists are so careful when the check what they give you." (P17, female, >70 age group)*

Participants' recognition of the advantages of medicines reuse was juxtaposed with assertions about a need for quality and safety assurances. Pharmacists were trusted to carry out quality and safety checks, but participants worried if pharmacists had the time to devote to such assurances (detailed further in the section entitled "Expectations about medicines reuse").

**Table 4.1 The compositional structure of category 1: "Consequences of medicines reuse"**

| **Consequences of medicines reuse**<br>Participants' attitudes towards medicines reuse involved an evaluation of the benefits and the risks associated with the distribution of returned medicines to other patients: |
|---|
| ***Potential advantages of medicines reuse*** |
| A) Economic impact on the NHS<br>- *Direct monetary savings for the NHS*<br>- *Reduction in manufacturing expenditure*<br>- *Cost-benefit of reusing cheaper medicines* |
| B) Environmental effects<br>- *Reduction in negative environmental effects of medicines disposed inappropriately*<br>- *Reduction of the carbon footprint.* |
| ***Potential disadvantages of medicines reuse*** |
| A) Poor quality medication<br>- *Temperature of storage*<br>- *Humidity of storage environment*<br>- *Cleanliness of the storage environment* |
| B) Harmful medication<br>- *Deliberate or malicious tampering with returned medicines*<br>- *Medicines as a source of infection if contaminated* |
| C) Incorrect medication<br>- *Errors introduced by patients*<br>- *Errors introduced by pharmacists*<br>- *Risk posed by accepting counterfeit medicines* |

### 4.4.2 Exemplar and anti-exemplar individuals and groups

This category encapsulates participants' understanding of individuals or groups of people who would partake or particularly engage with and promote medicines reuse (exemplar

individuals and groups) and those who would not (anti-exemplar individuals and groups) if a scheme were to be implemented in the future (see Table 4.2).

#### *4.4.2.1 Individuals or group of people who might approve of medicines reuse*

Those subscribing to the ideology of the 'Green movement' were considered to support medicines reuse, with spouses and partners, relatives and friends who *think green*, environmentalists and members of the Green Party, identified as people who might encourage medicines reuse. For example:

> *"I'm a dyed in the wool Conservative, but I think the Green Party for example would be positive about medicine reuse and may campaign for it." (P2, male, >70 age group)*

> *"I think people part of the Green movement will approve medicine reuse."(P3, male, 40-49 age group)*

> *"I think my husband and some friends, I think people who thinks green would support it. I would have thought most environmentalists would support it because the other things is, a lot of this stuff does end up in the water somehow or other, and affects wildlife." (P17, female, >70 age group)*

#### *4.4.2.2 Individuals or groups of people who might disapprove of medicines reuse*

Pharmaceutical companies and their employees (or others with an interest in these companies) were considered among the group that would disapprove of medicines reuse because of a potential to reduce financial profits. For example:

*"I think drug manufacturers may think that medicine reuse is a bad idea, because they are making an absolute fortune out of the NHS." (P6, male, >70 age group)*

*"I wonder if people working in pharmaceuticals would not frown upon it in some way if their profits are being affected." (P11, female, 40-49 age group)*

*"I'm very suspicious of the pharmaceutical companies as they like to produce more drugs and they make more money, so really I'm very suspicious because they are enormous conglomerates. It's to their benefit because they make a lot of money, absolutely." (P18, male, >70 age group)*

Longstanding taxpayers were another group who might disapprove of medicines reuse because of a sense of entitlement to receive 'the genuine medicine'. For example:

*"Getting access to the NHS services is at the cost of the UK taxpayer. I think because it's so ingrained in this country, the NHS and the prescription process, that people almost feel that it is now like an entitlement to have the genuine medicine at a fixed cost, and that kind of thing."(P1, female, 60-69 age group)*

Participants on the whole believed that people, especially mothers, may not approve of medicines reuse for their children, with babies particularly seen as a 'very special group'. For example:

*"I think mothers are probably very cautious for their offspring, and wants the best for her child, there's a kind of feeling because it's brand new, off the shelf, it's purer, it's safer, there's no element of risk." (P2, male, >70 age group)*

*"I think people might be resistant for example with drugs that are for babies. I think that might be seen as a very special group." (Participant 7, female, 60-69 age group)*

Participants had contradicting thoughts regarding the stance taken by 'the elderly'. Some thought older people would support reusing medicines because they were brought up not to waste things as a result of a natural aversion to waste stemming from experiencing shortages around the Second World War; this was compared to a younger generation who might dislike using 'second hand medicines'. For example:

*"I think particularly amongst the older generation would probably be more susceptible to saying, yeah medicine reuse is good idea, because we were brought up not to waste things. I do not know if youngsters think about that kind of thing as much because there is a surplus of everything these days but there was not when we grew up so we don't, we still don't waste things, we still mend things." (P17, female, >70 age group)*

*"…I think older people, the make do and mend generation who experienced shortages after Second World War, who are fast becoming rare and rarer" (P14, male, 60-69 age group)*

Others thought that the elderly might in fact disapprove of medicines reuse if they have a terminal illness or might be more cautious and concerned about the safety of returned medicines.

*"Elderly people, I think might think that you shouldn't do that when it comes to elderly people, people with maybe cancer, and these kind of very serious disease." (P7, female, 60-69 age group)*

**Table 4.2 The compositional structure of category 2: "Exemplar and anti-exemplar individuals and groups"**

| **Exemplar and anti-exemplar individual**<br>**The groups of individuals or people whom the participants thought would or would not engage with and approve of medicines reuse.** |
|---|
| ***Individuals or groups of people who might approve of medicines reuse*** |
| A) The Green movement<br>- *Spouses and partners, relatives and friends who 'think green'*<br>- *Environmentalists*<br>- *The Green Party, the political organisation* |
| B) The elderly<br>- *Those with a dislike of waste and an affinity for frugality* |
| ***Individuals or groups of people who might disapprove of medicines reuse*** |
| A) Pharmaceutical companies<br>- *Employees*<br>- *Beneficiaries* |
| B) Taxpayers<br>- *UK Taxpayers with a sense of entitlement* |
| C) Vulnerable patients (those making a decision for them)<br>- *Babies*<br>- *Children* |
| D) The elderly<br>- *Cautious individuals worried about safety*<br>- *Terminally ill patients* |

### 4.4.3 Expectations about returned medicines

This category encapsulates participants' understanding of factors that may facilitate or impede the workability of medicines reuse as a formal process and is expressed in terms of the participants' expectations about returned medicines (see Table 4.3).

#### *4.4.3.1 Physical characteristics of returned medicines*

It was clear that not all returned medicines were considered as suitable for medicines reuse. There was general agreement that reused medicines should be those originally packaged in sealed or in blister-pack containers, be unopened, comprise of oral solid dosage forms only, be a genuine medicine (not a counterfeit), and have more than 6 months of shelf-life remaining. In contrast, returned medicines that have a broken seal, have been opened, liquids and injectable medicines, controlled drugs, medicines with less than 6 months of shelf-life remaining, and medicines obtained from mistrusted or online sources would be excluded from the reuse process. For example:

> *"I don't think medicine in a liquid form can be reused, someone might introduce something such as foreign body. This apply to gel and cream which is maybe easier to inject or get something in it, whereas in a blister pack you can tell whether it is been tampered with or not." (P7, female, 60-69 age group)*

> *"If the returned medicine has only six months life left then it may not be put back on the shelf to give it to some people."(P9, female, >70 age group)*

> *"I can understand why opened packets have to be destroyed, as there is too high a risk of being tampered with. But there should be a way of reusing those unopened*

*medicines, and those still within date, I do not know what would need to be put in place, but it just seems wrong to bin them." (P10, male, 60-69 age group)*

#### *4.4.3.2 The quality assurance of returned medicines*

In addition to physically checking returned medicines, there should be stringent quality and safety checks by the pharmacist, to confirm suitability for reuse. The checking process would involve the pharmacist confirming storage conditions and discounting any risk of product degradation, contamination or infection. The pharmacist would check that the product had not been tampered with, maliciously or accidentally, damaged, bought from an online source, and was not a counterfeit. For example:

"*I would be quite happy to reuse medicines as long as I know that the safeguards have been put in place that the returned medicines has not been tampered with." (P4, female, 60-69 age group)*

*"I think another key thing is temperature control, I think most people would have a medicine cabinet in the bathroom, and that always amuses me because you have got the humidity and the heat of showers and baths. So I think whenever people buy medicine cabinets there should be an instruction saying don't use them in a bathroom." (P5, Male, 60-69 age group)*

*"So all returned medicine have to be checked, I suppose there is a slight risk of having counterfeit medicines from untrusted sources include those bought online getting into pharmacy shelf." (P17, female, >70 age group)*

#### *4.4.3.3 The logistics of medicines reuse*

The medicines reuse processes including the collection and the redistribution of returned medicines were considered in depth by the participants. Medicines could potentially be returned to pharmacies (CPs, pharmacies within the GP clinics, and hospital pharmacies) and assessed 'on-site'. Pharmacists were considered to be the professional group qualified to quality assure the suitability of returned medicines for reuse purposes. Potential challenges to an on-site system were the pharmacist's availability for collecting and checking returned medicines, space within a pharmacy to enable processing and storage of returned medicines, and whether the process of returning medicines would be slick and rapid for patients (which was preferred to having to queue). For example:

> *"As all returned medicine have to be checked. So this could be a disadvantage in terms of pharmacists' time because they are very busy in chemists, aren't they? Very busy pharmacists." (P17, female, >70 age group)*

> *"Pharmacist may not have the room to put back medicines into the shelf , I am thinking of our pharmacy, it is small, and maybe there is no enough space in the pharmacy for the returned medicines." (P6, male, >70 age group)*

Because of these challenges some of the participants proposed an alternative model whereby medicines would be dropped off in a specified area within a pharmacy without the need to speak to any staff. Those medicines would be despatched to a clinical centre where a pharmacist or trained technician completes a quality check in an 'off-site' model. An additional idea was to repackage returned medicines before returning them to pharmacies for reuse. However, the costs associated with having an off-site system were highlighted as

potentially prohibitive. Some participants thought that pharmaceutical companies should be obliged to support medicines reuse processes financially or even help in the repackaging process. For example:

> *"I think the pharmaceutical companies will have to collaborate to help in medicine reuse process, I know this is terrible thing, because they're all in competition, but it would be good if they could have some way of collaborating whereby the pooled, they all put money into these centres to fund it as almost like a, not exactly a charity, but like a community investment type idea." (P7, female, 60-69 age group)*

> "*Medicines have labels on them, so one assumes that if you gave them back to the pharmacy, for example, he would then have to send them back to the supplier, the supplier would have to send them back to the manufacturer, the manufacturer would then have to repackage them, and then they have to come all the way back down the chain." (P12, female, 60-69 age group)*

Incentives were thought to encourage patients to return unused medicines instead of unsafe disposal practices. Incentives could include a point's reward system to encourage medicines return or a discount to be offered on any medicines reused.

> *"I would have a knowledge of my pharmacist because I go to the same place and they know what medication I'm on and if somebody has changed their medication or whatever and so returns some tablets and the pharmacist know that I take those. So pharmacist can probably say here we are Mr. X, here is those returned tablet and they are 50 pence instead of £1 or whatever it is. So that sort of thing." (P14, male, 60-69 age group)*

**Table 4.3. The compositional structure of category 3: "Expectations about returned medicines".**

| **Expectations about returned medicines**<br>Factors that may facilitate or impede the workability of medicines reuse for individuals. |
|---|
| ***Physical characteristics of returned medicines*** |
| A) Original packaging of the medicine<br>- *Medicines sealed by the manufacturer potentially suitable to be reused*<br>- *Medicines in blister packaging potentially suitable to be reused* |
| B) Whether the packaging had been opened or not<br>- *Only unopened and sealed medicines to be reused*<br>- *Medicines not sealed or with a broken seal not to be reused* |
| C) Remaining shelf life of medication<br>- *Medicines should have more than six months of shelf-life if to be reused* |
| D) Pharmaceutical presentation (formulation) of the product<br>- *Solid oral dosage forms potentially suitable to be reused*<br>- *Liquid, creams and gels, and injections not to be reused* |
| ***The quality assurance of returned medicines*** |
| A) Storage conditions<br>- *Temperature and humidity of storage environment and risk of degraded product*<br>- *Cleanliness of the storage environment and risk of spread of infection* |
| B) Tampered product<br>- *Malicious damage to the product to be ruled out*<br>- *Accidental damage to the product to be ruled out* |
| C) Counterfeit medicines<br>- *Medicines bought from untrusted sources including online sources not to be reused* |
| ***The logistics of medicines reuse*** |
| A) Collection and redistribution of returned medicine 'on-site' within a pharmacy setting<br>- *Efficiency of system for returning medicines*<br>- *Space for collection, processing and storage of returned medicines*<br>- *Pharmacists' time availability to conduct quality assurance of returned medicines* |

| **Expectations about returned medicines**<br>Factors that may facilitate or impede the workability of medicines reuse for individuals. |
|---|
| |
| B) Collection and redistribution of returned medicines 'off-site'<br>- *Collection spots within pharmacies*<br>- *Clinical centres responsible for processing medicines for reuse*<br>- *Pharmaceutical companies to be involved in funding and supporting reuse processes* |
| C) Incentives for taking part in medicines reuse<br>- *Points reward system to encourage the return of medicines*<br>- *Discount on medicines to encourage the reuse of medicines* |

### 4.4.4 Medicines reuse definition

According to the results from TA and relating to TPB, a working definition of medicines reuse as a behaviour coalesced as: *"Accepting prescribed medication with more than 6 months of shelf-life remaining that, as verified by a pharmacist, had been kept untampered for less than three months, under normal storage conditions and in an original sealed blister pack, by another patient before being returned to a community pharmacy".* People taking part in medicines reuse behaviour were seen as *"Adult patients prescribed medication for a chronic (not terminal) condition with the capacity to consent".*

## 4.5 Discussion

This chapter described phase 1 of the larger study the results of which are briefly summarised here. A working definition of medicines reuse as a behaviour was produced. In addition, people's ideas about the advantages and disadvantages of medicines reuse, who might approve or disapprove of medicines reuse, and factors that would impede or facilitate medicines reuse were mapped systematically using thematic analysis. The principle findings were; the potential for medicines reuse to impact positively on the deleterious

economic and environmental impact of medicines waste were juxtaposed against a range of stability and safety risks identified with reusing returned medicines. While participants had trust in pharmacists' competence to quality assure returned medicines, they expressed concerns about their availability and access to sufficient storage space to support medicines reuse processes. Environmentalists and the Green Party were seen as the main proponents of medicines reuse behaviour with drug manufacturers and beneficiaries, some taxpayers, and those caring for children seen as the main opponents – there were contradictory views about the stance of the elderly. The physical characteristics of reused medicines, and quality assurance and logistics of medicines reuse processes were considered as factors that enabled or obstructed engagement in medicines reuse.

During the qualitative study, the face to face interview approach was chosen over focus groups. The reason behind choosing face to face interviews is that, first TPB is about individual intentions and not that of a group of people and their opinions, and second there was a risk of people leading each other during focus groups which will affect the results of this research (Ajzen, 1991; Ajzen, 2011; and Ajzen, 2017). In addition, semi-structured face to face interview was chosen over full in-depth unstructured interviews, first because of the use of TPB which requires a deductive approach mapping people's answers to the theory's framework, secondly, because of the purpose of this study which was to develop and construct the MRQ which in turn required the mapping described above to be completed.

One of the strengths of the current study is the application of TA to summarise key themes and to formalise views that the general public hold about medicines reuse, which had only been reported anecdotally and not appropriately investigated until now. The decision to

apply thematic analysis (TA) was influenced by simplicity and theoretical freedom of TA and its ability of providing rich and detailed themes, but also because TA allow for inductive, deductive and mixed inductive-deductive approaches (Braun and Clarke, 2006). Other options were not used because they would have introduced unnecessary complexity. For example grounded theory would have generated more theory rather than mapping to the TPB) (Goulding, 2017).

Themes obtained in this study have defined what people understand by medicines reuse behaviour as well as behavioural, normative and control beliefs. These are the domains that according to the TPB are relevant for predicting whether people intend to reuse medicines (Ajzen, 2006). This psychologically driven approach is another strength of the current study which provides a mechanism for measuring people's intentions to engage in medicines reuse behaviour, with a further potential for this approach to be useful in wanting to change people's intentions in the future. However, the views are not likely to be representative of the general UK population, firstly because thematic analysis was completed with a small sample of nineteen participants and secondly, because the sample was a self-selected sub-group of the local population who responded to a call to discuss medicines reuse.

There has been little work done previously at examining perceptions about medicines reuse in the UK apart from a study that used a modified Delphi design to examine whether pharmacists from one Health Board in South East Wales could come to some consensus on the barriers and potential solutions towards medicines reuse (McRae et al., 2016a). The results showed that pharmacists would be willing to redistribute medicines if certain criteria were met such as being solid dosage forms with a tamper evident seal. Results from

our study showed that participants also referred to sealed blister packs as the type of product that would be a part of medicines reuse. Other criteria expressed by pharmacists in the study by McRae et al. (2016a) included liability protection for pharmacists taking part in medicines reuse, guidance from the professional regulator, that reused medicines must be supplied in new packaging, that technologies would need to be developed to indicate inappropriate storage, and that there must be public engagement on medicine redistribution. Accordingly, this is the first study in the UK that has captured the general public's views and intentions toward reusing medicines that are returned to pharmacies. The work in this thesis was completed independently of the above study by McRae et al. (2016a), and addresses the feasibility of medicines reuse from the perspective of the general public, without whose approval medicines reuse could not become a reality.

Based on the results from TA (i.e. this elicitation study), the next steps are to develop and test a formal questionnaire that can capture systematically nationwide views of medicines reuse and people's intentions to reuse medicines in the future. Therefore the next phase (i.e. phase 2) of this study focussed on the construction and validation of a medicines reuse questionnaire, described in the next chapter.

## 4.6 Conclusion

This study suggests that people could potentially agree to reuse medicines that are returned to pharmacies if their concerns about safety and quality of the returned medicines are addressed, the physical characteristics of medicines are satisfactory, and the medicines reuse process is well defined and managed. This is a qualitative study with a small number of participants recruited from one local area in the UK meaning that the results are not necessarily generalizable. However, the mixed inductive deductive approach strengthens

the themes generated as TBP's deductive categorisation of the themes enhanced the interpretative power of thematic analysis. The themes generated will enable a structured questionnaire to be developed for quantifying broader, nationwide views (i.e. views drawn from respondents from around the UK) about medicines reuse and people's intention to reuse medicines in the future. That work is described in the next chapter.

# CHAPTER 5 DEVELOPMENT OF THE MEDICINES REUSE QUESTIONNAIRE: CONSTRUCTION, VALIDATION, AND PILOTING

## 5.1 Introduction

There was no existing questionnaire in the literature that could be used to measure people's beliefs and intentions toward reusing medicines. The Medicines Reuse Questionnaire (MRQ) was developed specifically to address the research objectives of this thesis. The research method was first to categorise themes obtained from the elicitation study (i.e. qualitative interviews) against the indirect measures of the TPB (behavioural beliefs, normative beliefs, and control beliefs) in order to develop the MRQ items of the indirect measures. Items of the direct measures (attitude toward the behaviour, subjective norms, and perceived behavioural control) and intention, and the background factor items were developed according to the recommendation by Ajzen (2006) and Francis et al. (2004). The details about the construction and development of the MRQ are described in the next section.

## 5.2 Aims and objectives

The aims of phase 2 of the study were to:

a) Construct the MRQ items using both direct and indirect measures including background factors that are related to the behaviour (i.e. medicines reuse behaviour).
b) To standardised the MRQ items using pilot tests.

The objectives of phase 2 described in this chapter were:

b) To use the TPB framework as a tool to develop the MRQ items.
c) To use validity and reliability tests to validate and standardise the MRQ items.

## 5.3 Methods

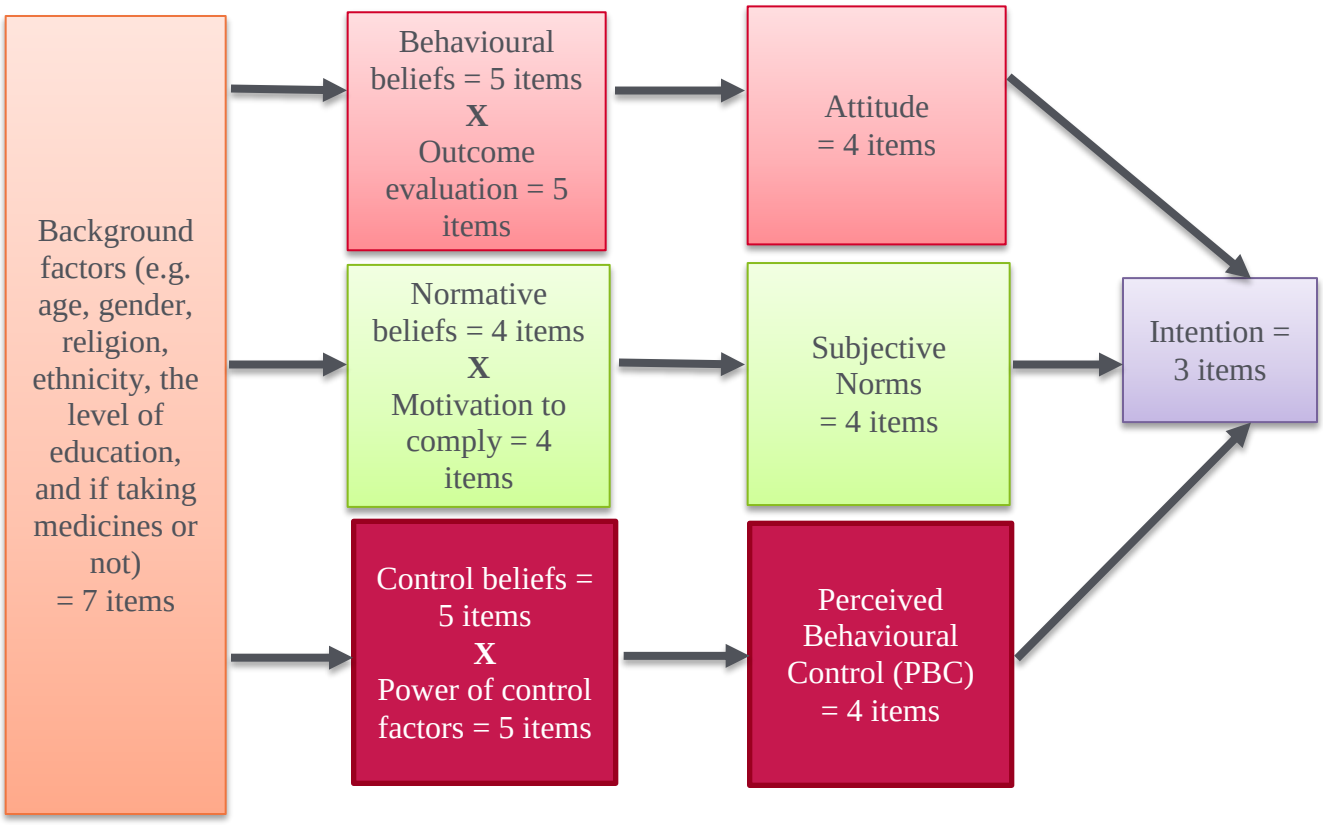
An amendment to ethical application (reference number 30/15) was submitted to the University Reading's Research Ethics Committee and was approved on 10/02/2017. The amendment contained information about the use of online platforms (e.g. Bristol online and Qualtrics), recruitment of University of Reading staff and students via university internal email system (chapter 4), and online recruitment using Market Research Company, online panel and online platform (chapter 5).

MRQ items were first constructed, then underwent validation and pilot testing including; content validity (CV) and confirmatory Factory Analysis (CFA), reliability testing using internal consistency of direct measures (Cronbach's alpha), and test re-test (Pearson correlation). The validity and reliability testing is described in the next sections of this chapter.

## 5.4 Construction and development of MRQ using TPB framework

In total, the MRQ (first version – v1) consisted of 50 items (Appendix 9). Twelve items relating to the direct measures and 3 items relating to intention construct were developed according to the recommendation by Ajzen (2006) and Francis et al. (2004). Twenty eight items relating to indirect measures and 7 items asking information about demographics were developed according to the results from the elicitation study. The numbers of items that were developed for each construct are presented in Figure 5.1. The MRQ has two parts. Items in the main part were developed using a 7-point Likert scale for responses and focussed on reusing sealed, returned blister-pack medication. Items in the section focussing on background factor were developed using multiple choice responses and included demographics information such as age, gender, religion, ethnicity, the level of education.

**Figure 5.1 The number of the items developed for each construct of the TPB**




### 5.4.1 Developing the MRQ items of the indirect measures of TPB

The items in the indirect measures were developed using a 1 to 7 unipolar Likert scale for behavioural beliefs, motivation to comply and control belief. For outcome evaluation, normative belief, and power of control factor, the unipolar Likert scale was recoded into bipolar (-3 to +3) Likert scale as recommended by Francis et al. (2004) and Ajzen (2006). The recoding allowed items developed to be measured using a weighting process involving one unipolar and one bipolar scale. The method of multiplying scores on a unipolar scale by scores on a bipolar scale was used to calculate and make the composite score interpretable (Francis et al., 2004; Ajzen, 2006). Table 5.1, Table 5.2, and Table 5.3 describe how the composite score was calculated for indirect measures of attitude, subjective norm and PBC.

**Table 5.1 Calculating the composite score of attitude (indirect measures) by multiplying scores on a unipolar scale of behavioural beliefs items by scores on a bipolar scale of outcomes evaluation items.**

| Behavioural beliefs items | Outcomes evaluation items |
|---|---|
| a. I think for me to contribute toward reducing the harmful effects of medication on the environment is:<br>*extremely bad 1 2 3 4 5 6* ***7*** *extremely good* | f. Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment is:<br>*definitely disagree -3 -2 -1 0 1 2* ***3*** *definitely agree* |
| b. I think for me to contribute toward reducing the NHS drug expenditure is:<br>*extremely bad 1 2 3 4 5* ***6*** *7 extremely good* | g. Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure:<br>*definitely disagree -3 -2 -1 0 1* ***2*** *3 definitely agree* |
| c. I think for me to receive low quality medication is:<br>*extremely bad 1* ***2*** *3 4 5 6 7 extremely good* | h. Reusing sealed, returned blister-pack medication will result in me receiving low quality medication: *definitely disagree -3* ***-2*** *-1 0 1 2 3 definitely agree* |
| d. I think for me to receive unsafe medication is:<br>*extremely bad* ***1*** *2 3 4 5 6 7 extremely good* | i. Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication: *definitely disagree* ***-3*** *-2 -1 0 1 2 3 definitely agree* |
| e. I think for me to receive incorrect medication is:<br>*extremely bad* ***1*** *2 3 4 5 6 7 extremely good* | j. Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication: *definitely disagree* ***-3*** *-2 -1 0 1 2 3 definitely agree* |
| For each behavioural belief, the belief score on the *extremely bad - extremely good* scale is multiplied by the relevant outcome evaluation score on the *definitely disagree - definitely agree* scale.<br>Total attitude (indirect measurement) score = (a x f) + (b x g) + (c x h) + (d x i) + (e x j).<br>For example, if the participants responded by choosing the bold numbers as above then,<br>Total attitude (A) = (7 x 3) + (6 x 2) + (2 x -2) + (1 x -3) + (1 x -3)<br>Total (A) = **+23**. Because there are 5 items, the possible range of total scores is (7 x ±3) x 5 = **-105 to +105**<br>Total A score = **+23** reflects a weak positive attitude toward reusing medicine. | |

**Table 5.2 Calculating the composite score of subjective norm (indirect measures) by multiplying scores on a unipolar scale of motivation to comply items by scores on a bipolar scale of normative beliefs items.**

| Normative belief items | Motivation to comply items |
|---|---|
| a. Environmentalists would believe that I should reuse sealed, returned blister-pack medication:<br>*definitely disagree -3 -2 -1 0 1 2* ***3*** *definitely agree* | e. Generally speaking, how much do you want to do what environmentalists believe you should do?<br>*Not at all 1 2 3 4 5 6* ***7*** *very much* |
| b. The pharmaceutical industry would believe that I should reuse sealed, returned blister-pack medication:<br>*definitely disagree -3 -2* ***-1*** *0 1 2 3 definitely agree* | f. Generally speaking, how much do you want to do what pharmaceutical industry believes you should do?<br>*Not at all* ***1*** *2 3 4 5 6 7 very much* |
| c. My close friends would believe that I should reuse sealed, returned blister-pack medication:<br>*definitely disagree -3 -2 -1 0 1* ***2*** *3 definitely agree* | g. Generally speaking, how much do you want to do what close friends believe you should do?<br>*Not at all 1 2 3 4 5* ***6*** *7 very much* |
| d. My family would believe that I should reuse sealed, returned blister-pack medication:<br>*definitely disagree -3 -2 -1 0 1 2* ***3*** *definitely agree* | h. Generally speaking, how much do you want to do what your family believes you should do?<br>*Not at all 1 2 3 4 5 6* ***7*** *very much* |
| For each normative belief, the belief score on the *definitely disagree - definitely agree* scale is multiplied by the relevant motivation to comply score on the *Not at all - very much* scale.<br>Total subjective norm (indirect measurement) score = (a x e) + (b x f) + (c x g) + (d x h).<br>For example, if the participants responded by choosing the bold numbers as above then,<br>Total subjective norm (SN) = (7 x 3) + (-1 x 1) + (2 x 6) + (3 x 7)<br>Total (SN) = **+53**, Because there are 5 items, the possible range of total scores is (7 x ±3) x 4 = **-84 to +84**<br>Total A score = **+53** reflects moderate positive subjective norm toward reusing medicine. | |

**Table 5.3 Calculating the composite score of PBC (indirect measures) by multiplying scores on a unipolar scale of control beliefs items by scores on a bipolar scale of power of control factors items.**

| Control beliefs items | Power of control factors items |
|---|---|
| a. I expect that any medication offered to me for reuse will be in the original, sealed, blister-packaging: *definitely no 1 2 3 4 5* ***6*** *7 definitely yes* | f. It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister-packaging: *strongly disagree -3 -2 -1 0 1* ***2*** *3 strongly agree* |
| b. I expect to see evidence that any medication offered to me for reuse would have been quality-checked: *definitely no 1 2 3 4 5 6* ***7*** *definitely yes* | g. It would make it easier for me to reuse medication if I could see that it had been quality-checked: *strongly disagree -3 -2 -1 0 1 2* ***3*** *strongly agree* |
| c. I expect to see evidence that any medication offered to me for reuse would have been safety-checked: *definitely no 1 2 3 4 5 6* ***7*** *definitely yes* | h. It would make it easier for me to reuse medication if I could see that it had been safety-checked: *strongly disagree -3 -2 -1 0 1 2* ***3*** *strongly agree* |
| d. I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining: *definitely no 1 2 3 4* ***5*** *6 7 definitely yes* | i. It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining: *strongly disagree -3 -2 -1 0* ***1*** *2 3 strongly agree* |
| e. I expect to be offered some form of reward for reusing medication: *definitely no 1 2 3* ***4*** *5 6 7 definitely yes* | j. It would make it easier for me to reuse medication if I were offered some form of reward: *strongly disagree -3 -2 -1* ***0*** *1 2 3 strongly agree* |
| For each control belief, the belief score on the *definitely no - definitely yes* scale is multiplied by the relevant power of control factor score on the *strongly disagree - strongly agree* scale.<br>Total Perceived behavioural Control (indirect measurement) score = (a x f) + (b x g) + (c x h) + (d x i) + (e x j).<br>For example, if the participants responded by choosing the bold numbers as above then,<br>Total Perceived behavioural Control (PBC) = (6 x 2) + (7 x 3) + (7 x 3) + (5 x 1) + (4 x 0)<br>Total (PBC) = **+59**, Because there are 5 items, the possible range of total scores is (7 x ±3) x 5 = **-105 to +105**<br>Total PBC score = **+59** reflects moderate positive PBC toward reusing medicine. | |

Positive scores reflect that the participants have more favourable attitudes; social pressure to perform the behaviour (i.e. medicines reuse); and control factors that make medicines reuse more likely to happen. Negative scores reflect that the participants have less favourable attitudes; less social pressure to perform the behaviour; and control factors that make medicines reuse less likely to happen.

In total, 28 items were developed; 10 items for the indirect attitude construct (5 items for behavioural beliefs and 5 items for outcome evaluation), 8 items for the indirect subjective norm construct (4 items for normative beliefs and 4 items for motivation to comply), and 10 items for the indirect PBC (5 items for control beliefs and 5 items for power of control factor).

### 5.4.2 Developing the MRQ items of the direct measures of TPB

The items in the direct measures were developed using a 1 to 7 unipolar Likert scale. The endpoints of the attitude items were constructed using bipolar adjectives described as a pair of opposites (e.g. good-bad, harmful-beneficial; satisfying-dissatisfying; worthless-worthwhile). The attitude items included both instrumental (whether reusing medication achieves something e.g. worthless-worthwhile) and experiential items (how it would feel to reuse medication e.g. satisfying-dissatisfying, good-bad). The mixing of positive and negative endpoints are described in Table 5.4, and was used to reduce the risk of having response set, or having a tendency to answer the MRQ items in the likely manner neglecting their content. Although the idea of mixing positive and negative endpoint is to force respondents to think about their response, there is no guarantee that the respondents will fully observe the questions when answering. Moreover, overusing this technique (i.e.

mixing of positive and negative endpoint) for many question may end up that the respondents feel that they need to interrupt their completion of the questionnaire and so they may not complete the questionnaire or may not notice the differences leading to unwanted errors and incorrect responses. In this research, there was no overuse of mixing negative and positive endpoints, instead only a few questions were developed using mixing of positive and negative endpoint as recommended by Francis et al. (2004) and Ajzen (2006).

**Table 5.4 Calculating the mean of the item scores to give an overall attitude score**

| **Attitude** |
|---|
| a. Reusing medication in the future is:<br>*Harmful 1 2 3* ***4*** *5 6 7 beneficial* |
| b. Reusing medication in the future is:<br>*good 1* ***2*** *3 4 5 6 7 bad……..negative endpoint* |
| c. Reusing medication in the future is:<br>*satisfying (for me)* ***1*** *2 3 4 5 6 7 dissatisfying (for me) ……..negative endpoint* |
| d. Reusing medication in the future is:<br>*worthless 1 2 3 4 5 6* ***7*** *worthwhile* |
| Attitude items used a mix of positive (a and d) and negative endpoints (b and c).<br>Items with negative endpoints (b and c), were recoded so that the higher number reflects the positive attitude to the target behaviour. For example, an answer of 7 becomes a score of 1, five become a score of 3, and 4 remains 4.<br>The mean of the item scores is calculated to give an overall attitude score.<br>Mean = (4 + 6 (after recoding) + 7 (after recoding) + 7) / 4 = **6** |

The endpoints of the items in subjective norms (the perceived social pressure to perform the behaviour or not) construct were developed using items referring to the opinion of important people in general. Items using the response format that completed an otherwise incomplete sentence (I should/I should not) were arranged so that the end of the scale was a negative endpoint (e.g. most people who are important to me would think that I should / I should not reuse medication in the future). However, items using the response format (strongly disagree/strongly agree) of a complete sentence were arranged so that the end of the scale was a positive endpoints. For example, most people who are important to me would want me to reuse medication in the future (Table 5.5).

**Table 5.5 calculating the mean of the item scores to give an overall subjective norm score**

| **Subjective norm** |
|---|
| a. I would feel under social pressure to reuse medication in the future:<br>*strongly disagree 1 2 3* ***4*** *5 6 7 strongly agree* |
| b. Most people who are important to me would want me to reuse medication in the future:<br>*strongly disagree 1 2 3 4 5* ***6*** *7 strongly agree* |
| c. It would be expected of me to reuse medication in the future:<br>*strongly disagree 1 2 3 4 5 6* ***7*** *strongly agree* |
| d. Most people who are important to me would think that ---------- reuse medication in the future:<br>*I should* ***1*** *2 3 4 5 6 7 I should not……..negative endpoint* |
| Subjective norm items used a mix of positive (a, b, and c) and negative endpoint (d).<br>Items with negative endpoints (d), were recoded so that the higher number reflect the positive subjective norm to reuse medicines in the future. For example, an answer of 7 becomes a score of 1, 5 becomes a score of 3, and 4 remains 4.<br>The mean of the item scores is calculated to give an overall subjective norm score.<br>Mean = (4 + 6 + 7 + 7 (after recoding)) / 4 = **6** |

The end points of PBC were developed using the internal (self-efficacy) and the external (controllability) dimensional control to reflect participant's confidence to reuse medication. Items representing self-efficacy measured whether participants felt confident about being able to reuse medication using a mix of negative (possible/impossible) and positive (strongly disagree/strongly agree) endpoints. For example, 'for me to reuse medication in the future is', and 'I am confident that I could reuse medication in the future if I wanted to', respectively. Items representing controllability measured whether participants felt that reusing medication is up to them or beyond their control using positive (strongly disagree/strongly agree) endpoints. For example, the decision to reuse medication in the future is beyond my control (Table 5.6).

**Table 5.6 Calculating the mean of the item scores to give an overall PBC score**

| **PBC** | |
|---|---|
| **Self-efficacy** | **Controllability** |
| a. I am confident that I could reuse medication in the future if I wanted to: *strongly disagree 1 2 3* ***4*** *5 6 7 strongly agree* | c. The decision to reuse medication in the future is beyond my control: *strongly disagree 1 2 3 4 5 6* ***7*** *strongly agree* |
| b. For me to reuse medication in the future is: *possible 1* ***2*** *3 4 5 6 7 impossible ……..negative endpoint* | d. Whether I reuse medication or not in the future is entirely up to me: *strongly disagree 1 2 3 4 5 6* ***7*** *strongly agree* |
| PBC items used a mix of positive (a, c, and d) and negative endpoint (b).<br>Items with negative endpoints (b), were recoded so that the higher number reflect the positive PBC to reuse medicines in the future. For example, an answer of 7 become a score of 1, 5 become a score of 3, and 4 remains 4.<br>The mean of the item scores is calculated to give an overall PBC score.<br>Mean = (4 + 6 (after recoding) + 7 + 7) / 4 = **6** | |

The composite scores for all variables in the direct measures (attitude, subjective norm, and perceived behavioural control) were calculated based on the mean of the items. In total, 12 items were developed according to the recommendation by Ajzen (2006) and Francis et al. (2004).

### 5.4.3 Developing the MRQ items of the intention construct

*A generalised intention method* was used to measure participant's intentions towards reusing medicines in the future. The decision to choose the *generalised intention method* was guided by the fact that this method allowed to develop three items using 1 to 7 unipolar Likert scale in which internal consistency can be demonstrated, therefore, the items developed using this method make sense to measure reusing medicine as a behaviour. In addition, the *generalised intention method* is the most commonly used method in TPB literature where most research has been about participant's own health-related behaviour such as would be for medication reuse (Francis et al., 2004). The *Intention performance* method, which is used to observe the actual behaviour, was not used in this study as medicines reuse is not allowed in the UK and the actual behaviour (i.e. medicines reuse) cannot be measured. Therefore, intention performance was not used. Also, it was decided not to use the *intention simulation* method. Although *intention simulation* appeared to be a valid measure to simulate the actual behaviour, it is very time consuming and sometimes misleading if it is not constructed carefully.

The composite scores for the three variables of intention were calculated based on the mean of the items. The three items developed to measure intention towards reusing medication were according to the recommendations by Ajzen (2006) and Francis et al. (2004) and using positive (strongly disagree / strongly agree) endpoints (Table 5.7).

**Table 5.7 Calculating the mean of the item scores to give an overall intention score**

| Intention |
|---|
| a. I expect to reuse medication in the future:<br>*strongly disagree 1 2 3* ***4*** *5 6 7 strongly agree* |
| b. I want to reuse medication in the future:<br>*strongly disagree 1 2 3 4 5* ***6*** *7 strongly agree* |
| c. I intend to reuse medication in the future:<br>*strongly disagree 1 2 3 4 5 6* ***7*** *strongly agree* |
| Intention items used positive (strongly disagree - strongly agree) endpoints.<br>The mean of the item scores is calculated to give an overall intention score.<br>Mean = (4 + 6 + 7 ) / 3 = **5.7** |

### 5.4.4 Developing the MRQ background factors items

In TPB, the information regarding the determinants of the behaviour is included in a person's behavioural, normative and control beliefs. However, TPB does not specify the roots of these beliefs. Instead, Ajzen linked the possible background factors that may have an effect and would influence the behaviour to construct of TPB. These background factors include information about people that is related to the behaviour; for example, and relating to medicines reuse; information about people's long-term condition and whether they were using medicines or not, were included in the MRQ. In addition, demographic variables such as age, gender, ethnicity, religion, and the level of education were also included in the MRQ as background factors (Ajzen, 2011).

In this thesis, background factor items were developed and added to the MRQ. These factors were expected to influence people's intention to reuse medicines in the future indirectly by their effect on the proximal determinants of TPB.

## 5.5 Developing the MRQ

The first draft (v1) of the MRQ (Appendix 9) included a set of items which assessed the three direct measures (predictor variables) of the intention (attitude construct, subjective norm construct, and perceived behavioural control construct), the belief-based items of the same three predictor variables developed from the elicitation study (behavioural belief construct, normative belief construct, and control belief construct), items assessing behavioural intention construct, and the background items that are related to medicines reuse as behaviour. The MRQ items were developed in line with Ajzen (2006) and Francis et al. (2004) guidelines and were piloted using validity and reliability tests as described in the next sections.

## 5.6 Validity and reliability of the MRQ

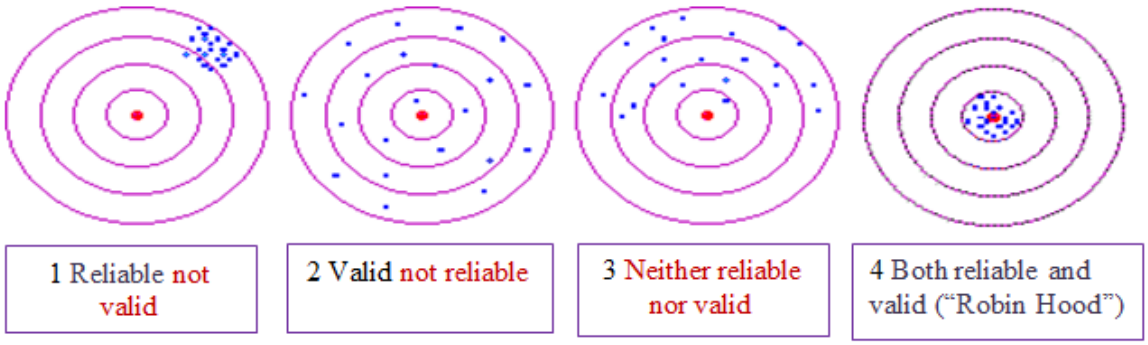
Validity and reliability are important concepts of the questionnaire measuring accuracy and consistency, respectively. Reliability is generally necessary for validity but it doesn't guarantee validity. Although both reliability and validity are considered separate concepts, in fact, they are related to each other. To clarify this more, the relationship between validity and reliability can be shown by the 4 different scenarios as below (Golafshani, 2003):

1. **Reliable and not valid**, the questionnaire measures the variable consistently but it doesn't measure what it is supposed to measure.
2. **Valid but not reliable**, the questionnaire measures what it is meant to measure but it is unstable/inconsistent.
3. **Neither reliable nor valid**, the questionnaire is inconsistent / unstable and does not measure what it is meant to measure.

4. **Both Reliable and valid**, the questionnaire is consistent / stable and measures what it is meant to measure.

For example, with reference to Figure 5.2 if the concept of medicines reuse were measured perfectly by the MRQ for a person, then it is like hitting the centre of the target. If not, then, it is like missing the centre. The more you are off target for that person, the further you are from the centre (Figure 5.2). To clarify more, first, if the hits are on the target consistently but missing the centre of the target then the MRQ is measuring consistently the wrong value for the participants (i.e. the MRQ is *reliable and not valid*). Second, if the hits are randomly spread across the target, but rarely hit the centre of the target, then the MRQ is getting the right answer for the group, but not very well for individuals (i.e. the MRQ is *valid but not reliable*). Third, if the hits are spread across the target and you are consistently missing the centre, the MRQ is *neither reliable nor valid.* Finally, if the hits are consistently on the centre of the target, then the MRQ achieved the "Robin Hood" scenario meaning that the MRQ is both *reliable and valid*. (Trochim, 2006). In this thesis, the aim was to develop the MRQ that is both *reliable and valid*, the "Robin Hood" scenario.

**Figure 5.2 The relationship between validity and reliability, adapted from Trochim (2006) and Bolarinwa (2015).**



### 5.6.1 Validity of the MRQ

#### *5.6.1.1 Content validity of the MRQ items*

Content Validity (CV) is the degree to which items in the questionnaire can fully cover, assess or measure the construct of interest in the questionnaire, meaning that these items must relate to the construct being measured (Shaughnessy and Zechmeister, 1985; Bolarinwa, 2015). To determine the validity of the MRQ, CV was explored by interviewing 11 of our experts panel (the response rate of our panel of expert was 58%, 11 out of 19 participant experts attended the cognitive interviewing). This was conducted using the 4-stage process of cognitive interviewing and asking CV questions about 1) understanding, 2) remembering, 3) judging and 4) relevance of each item on the MRQ. Respondents indicated their agreement or disagreement with each CV question on a 4-point Likert scale (4 = strong agreement, 1 = strong disagreement).

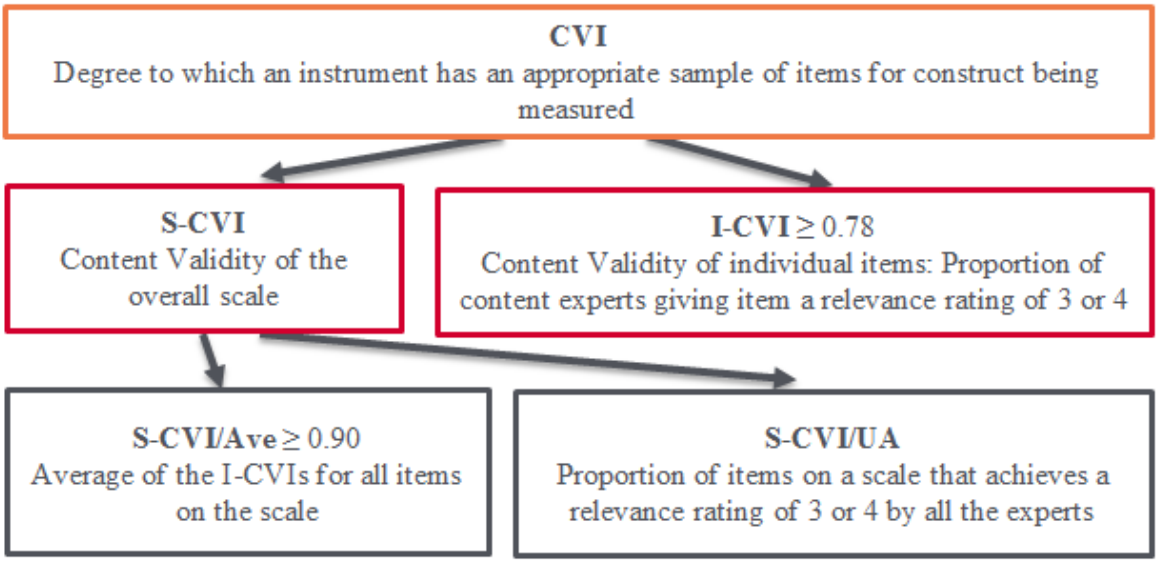
The cognitive interviewing questions were adapted from Tourangeau (1984), who identified a 4 stage process to explain how information is stored, retrieved, and organized by respondents to answer the questionnaire items. The 4 stage process applied to the MRQ were comprehension of each question (*understanding* of the question); retrieval of relevant information from memory (*remembering* the answer to the question); *relevance* and *judgment* of the information needed and formation of the response (Willis, 2015). The CV questions used for each MRQ item are shown in table 4.8.

**Table 5.8 The four CV questions which were used to assess each item in the MRQ using 4-point response scale**

| CV Questions for each item in the MRQ | Agreement or disagreement level | | | |
|---|---|---|---|---|
| | **Strongly agree** | **Agree** | **Disagree** | **Strongly disagree** |
| Q1. I ***understand*** what this question says | | ✓ | | |
| Q2. I would be able to ***remember*** the information needed in order to answer this question | ✓ | | | |
| Q3. I would be able to ***decide*** which response to choose | | | ✓ | |
| Q4. This question is ***relevant*** to measuring people beliefs about the concept of medicine reuse | | ✓ | | |

A Content Validity Index (CVI) was calculated for each item on the scale (I-CVI) as well as for the overall scale (S-CVI). According to recommendations by Polit et al. (2007), the MRQ scale to have an *excellent content validity*, should be composed of items with (I-CVI) of 0.78 or higher and an S-CVI/Ave of 0.90 or higher. The (I-CVI) of the MRQ was determined by calculating the proportion of the 11 experts who would have to give a rating of 3 or 4 to each of the four CV questions for each item. A minimum of 0.81 (I-CVI) was considered an acceptable value for an overall rating, which meant that 9 experts out of 11 would give a rating of 3 or 4 of the four CV questions. In addition, the (S-CVI/ Ave) and the (S-CVI/ UA) was also calculated to be 0.97 and 0.74 respectively. Definitions of CV terms are described in Figure 5.3.

**Figure 5.3 Definitions of content validity terms.**




I-CVI, item-level content validity index; S-CVI, scale-level content validity index; S-CVI/UA, scale-level content validity index, universal agreement calculation method; S-CVI/Ave, scale-level content validity index, averaging calculation method. Adapted from (Polit and Beck, 2006)

All 50 MRQ items were assessed as relevant for measuring people's intentions to participate in medicines reuse (I-CVI for responses to CV Q4 ≥0.83 for all 50 items). Agreement was also reached about remembering necessary information and making judgment needed for completing all MRQ items (I-CVI for responses to CV Q2 and 3 ≥0.83 for all 50 items). Regarding understanding what the question said, only 3 out of 11 panel members could not clearly understand 3 items (item 11, 12, and 37) out of 50 (was not clear in terms of their wording) and made recommendations on rephrasing (I-CVI for responses to CV Q1 item 11 and 12 were 0.73, and CV Q1 item 37 was 0.64). These three items were reworded as described in Table 5.9.

**Table 5.9 Rewording item 11, 12, and 37 according to CV results**

| Items before CV | Items after CV |
|---|---|
| 11. Environmentalists think that *I should 1 2 3 4 5 6 7 I should not* accept sealed, returned blister-pack medication | 11. Environmentalists would believe that *I should 1 2 3 4 5 6 7 I should not* reuse sealed, returned blister-pack medication |
| 12. Pharmaceutical industry think that *I should 1 2 3 4 5 6 7 I should not* accept sealed, returned blister-pack medication | 12. Pharmaceutical industry would believe that *I should 1 2 3 4 5 6 7 I should not* reuse sealed, returned blister-pack medication |
| 37. What is your gender?<br>a. Male b. Female | 37. What is your gender?<br>a. Male b. Female c. Other d. I prefer not to say |

#### *5.6.1.2 Data screening and construct validity*

A principal component analysis (PCA) was conducted with orthogonal rotation (varimax) using Statistical Package for Social Sciences (SPSS) software version 23. Data screening for multicollinearity (variables that are highly correlated) and singularity (variables that are perfectly correlated) was performed. The R matrix (or the correlation matrix) table, an SPSS output produced using the coefficient and significant levels options is shown in Appendix 10. The upper half of the table included the Pearson correlations coefficients between all pairs of the MRQ items. The lower half of the table contained the one-tail significance of these coefficients. The idea of the R matrix is that in order to run factor analysis, the variables should not have perfect correlation, instead it should have fair correlation. To clarify this more, the R matrix is used to check the relationship patterns. The R matrix output of the MRQ was scanned for any variables with correlation over 0.3,

then, correlation coefficients were scanned themselves for any value greater than 0.9 which may indicate that a problem could arise as a result of the multicollinearity. Although there was a possible risk of multicollinearity between control factors 2 and 3, and attitude 2 and 4 (as they have correlation of more than 0.3 and the correlation coefficients for themselves are > 0.9), the determinant for the R matrix was 6.124 E-17 (0.0006124). The determinant value confirmed that the multicollinearity is not a problem as it is greater than the necessary value of 0.00001 (Field, 2009).

The sampling adequacy for factor analysis was verified by the Kaiser–Meyer–Olkin (KMO) measure (i.e. factor analysis is appropriate for this data). The result of the KMO was 0.735 (good) for the multiple items, and all KMO values for individual items were > 0.59 (after checking the anti-image correlation matrix output), which is well above the acceptable limit of 0.5 (Field, 2009). Kaiser recommends a bare minimum of 0.5 for both multiple and individual items, and that values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and values above 0.9 are superb (Field, 2009; cited Hutcheson and Sofroniou, 1999).

The Bartlett's measure tests the null hypothesis that the original correlation matrix is an identity matrix. A significant Bartlett's test ($p < 0.05$), means that the R matrix is not an identity matrix and there is some relationships between the variables. In factor analysis, the value of Bartlett's test should be significant, meaning that it is important to have some relationships between variables. For the MRQ, the value of Bartlett's test of sphericity $\chi^2$ (253) was = 1287.947, $p < 0.001$, indicating that correlations between items were sufficiently large for PCA (

Table 5.10).

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | **0.735** |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1287.947 |
| | df | 406 |
| | Sig. | 0.000 |

**Table 5.10 Results of Kaiser–Meyer–Olkin (KMO) and Bartlett's Test from (SPSS output)**

The results of PCA, Bartlett's test, and KMO, showed that multicollinearity is not a problem, sufficient correlations exist, and there is sampling adequacy for factor analysis, respectively. As a result Confirmatory Factor Analysis (CFA) was performed.

CFA is a statistical test (method) used to help verify the factor structure of a set of the observed variables. CFA is theory driven, that is, the analysis is driven by the theoretical model to measure relationships between the observed and unobserved variables (Schreiber et al., 2006). When applying CFA, the theoretical model is used to estimate population covariance matrix that is compared with observed covariance matrix. The aim is to minimise the difference between estimated and the observed covariance matrices (Schreiber et al., 2006). CFA was performed using a sample of 46 participants using Analysis of a Moment Structures (Amos) SPSS software. The factor loadings for each item of the indirect and direct measures are shown in Table 5.11 and Table 5.12, respectively.

Items with low factor loading were either *deleted* (Control belief item number 5 as it is very low) or *rephrased* (normative belief item number 1 and 2, control belief item number 4, subjective norm item number 1 and 3, perceived behavioural control item number 3 and

4, although the factor loading is low and below the required 0.5, but it was decided to rephrase and to give these items another opportunity as their low factor loadings maybe due to small sample size).

**Table 5.11 Shows the factor loadings for the indirect measure of the MRQ item using Amos SPSS**

| MRQ items (indirect measures) | Construct | Factor loading |
|---|---|---|
| 1. I think for me to contribute toward reducing the harmful effects of medication on the environment is * Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment | Behavioural belief | 0.830 |
| 2. I think for me to contribute toward reducing the NHS drug expenditure is * Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure | Behavioural belief | 0.831 |
| 3. I think for me to receive low quality medication is * Reusing sealed, returned blister-pack medication will result in me receiving low quality medication | Behavioural belief | 0.760 |
| 4. I think for me to receive unsafe medication is * Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication | Behavioural belief | 0.889 |
| 5. I think for me to receive incorrect medication is * Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication | Behavioural belief | 0.801 |
| Environmentalists would believe that I should reuse sealed, returned blister-pack medication * Generally speaking, how much do you want to do what environmentalists believe you should do? | Normative belief | 0.358 |
| The pharmaceutical industry would believe that I should reuse sealed, returned blister-pack medication * Generally speaking, how much do you want to do what the pharmaceutical industry believes you should do? | Normative belief | 0.356 |

| MRQ items (indirect measures) | Construct | Factor loading |
|---|---|---|
| 1. My close friends would believe that I should reuse sealed, returned blister-pack medication * Generally speaking, how much do you want to do what close friends believe you should do? | Normative belief | 1.024 |
| 2. My family would believe that I should reuse sealed, returned blister-pack medication * Generally speaking, how much do you want to do what your family believes you should do? | Normative belief | 0.871 |
| 1. I expect that any medication offered to me for reuse will be in the original, sealed, blister-packaging * It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister-packaging | Control belief | 0.764 |
| 2. I expect to see evidence that any medication offered to me for reuse would have been quality-checked * It would make it easier for me to reuse medication if I could see that it had been quality-checked | Control belief | 1.007 |
| 3. I expect to see evidence that any medication offered to me for reuse would have been safety-checked * It would make it easier for me to reuse medication if I could see that it had been safety-checked | | 0.923 |
| 4. I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining * It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining | Control belief | 0.434 |
| 5. I expect to be offered some form of reward for reusing medication * It would make it easier for me to reuse medication if I were offered some form of reward | Control belief | 0.026 |

**Table 5.12 Shows the factor loadings for the direct measure and intention of the MRQ item using Amos SPSS**

| MRQ items (direct measure and intention) | Construct | Factor loading |
|---|---|---|
| Reusing medication in the future is *Harmful 1 2 3 4 5 6 7 beneficial* | Attitude | 0.960 |
| Reusing medication in the future is *good 1 2 3 4 5 6 7 bad* | Attitude | 0.966 |
| Reusing medication in the future is *satisfying (for me) 1 2 3 4 5 6 7 dissatisfying (for me)* | Attitude | 0.724 |
| Reusing medication in the future is *worthless 1 2 3 4 5 6 7 worthwhile* | Attitude | 0.961 |
| I would feel under social pressure to reuse medication in the future strongly disagree 1 2 3 4 5 6 7 strongly agree | Subjective norm | 0.264 |
| Most people who are important to me would want me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Subjective norm | 0.924 |
| It would be expected of me to reuse medication in the future strongly disagree 1 2 3 4 5 6 7 strongly agree | Subjective norm | 0.467 |
| Most people who are important to me would think that ---------- reuse medication in the future *I should 1 2 3 4 5 6 7 I should not* | Subjective norm | 0.779 |
| I am confident that I could reuse medication in the future if I wanted to *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Perceived behavioural control | 0.779 |
| For me to reuse medication in the future is *possible 1 2 3 4 5 6 7 impossible* | Perceived behavioural control | 0.878 |
| The decision to reuse medication in the future is beyond my control | Perceived behavioural control | 0.258 |

| MRQ items (direct measure and intention) | Construct | Factor loading |
|---|---|---|
| Whether I reuse medication or not in the future is entirely up to me | Perceived behavioural control | 0.019 |
| I expect to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Intention | 0.889 |
| I want to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Intention | 0.970 |
| I intend to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Intention | 0.939 |

### 5.6.2 Reliability testing of the MRQ items

Reliability is the ability of the questionnaire to produces the same results (constant results) under the same conditions over repeated observations, or referred sometimes as the stability or the consistency of the scores of the questionnaire items over time or across raters (Francis et al., 2004; Bolarinwa, 2015). Two methods were used to measure the reliability of the MRQ items. *Cronbach's alpha* coefficient as a measure of *internal consistency* of the items in the direct measures of TPB and *Pearson correlation* as a measure of *test-retest reliability* of indirect measures of TPB (Francis et al., 2004; Ajzen, 2006).

#### *5.6.2.1 Reliability of direct measures of TPB (internal consistency)*

The reliability of direct measures were calculated using Cronbach's alpha (α) coefficient to determine the internal consistency of direct measures of the MRQ constructs. The alpha (α) coefficient is an estimate of reliability based on the average of correlations between all

items in the scale. It is the current standard statistic for assessing the reliability of a scale composed of multiple items and it is the most appropriate reliability measure to use for Likert and semantic differential scales because these methods assume that the items are parallel sample measures of the same attitude content domain. The alpha (α) coefficient depends not only on the correlation between items but also on the number of items, therefore, longer scales tend to have a higher (α) coefficient value. As a result, the alpha (α) coefficient should be carefully interpreted for large scale questionnaires (Field, 2009).

The alpha (α) coefficient value ranges from 0 to 1 providing the overall evaluation of the measure's reliability. If all items are entirely independent (not correlated, or share no covariance) from one another then α = zero. If all items have high correlation or share high covariance then α will reach 1 (as the number of the items in the scale reach infinity). The alpha (α) values of <0.5 are usually not acceptable, with the minimum acceptable value to be in the range between 0.65 to 0.8 (Goforth, 2016).

The alpha (α) coefficient of the direct measures and intention construct was 0.904. The highest alpha (α) coefficient value was reported with intention 0.954 and attitude 0.935 constructs and lowest with perceived behavioural control constructs 0.303. Moreover, the alpha (α) coefficient value of the subjective norm construct was also within the acceptable range (0.706). The alpha (α) coefficient value of the PBC was not accepted as it was below 0.5, but improved first by deleting PBC item 4 (as the α value increased from 0.303 into 0.562), and then further improved by further deleting PBC items 3 as the α value further increased from 0.562 into 0.830 (Table 5.13). As a result, PBC items 3 and 4 were reworded to have new PBC 3 and 4 items.

**Table 5.13 The internal consistency (Cronbach's alpha) of the direct measures of the MRQ constructs**

| TPB construct | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|---|
| Direct measures construct and intention | 0.904 | 0.918 | 15 |
| Attitude | 0.935 | 0.944 | 4 |
| Subjective norm | 0.706 | 0.714 | 4 |
| **Perceived behavioural control (PBC)** PBC if **PBC item 4** deleted (Whether I reuse medication or not in the future is entirely up to me), PBC if **PBC item 3** (The decision to reuse medication in the future is beyond my control) **further** deleted (i.e. both PBC item 3 and 4 were deleted) | **0.303** **0.562** **0.830** | 0.366 | 4 |
| Intention | 0.954 | 0.955 | 3 |

### *5.6.2.2 Test re-test reliability of indirect measures (temporal stability)*

For the reliability assessment of indirect measures, it was not appropriate to use an internal consistency criterion (Cronbach's alpha), because different accessible beliefs may well be inconsistent with each other (i.e. people can logically hold both positive and negative beliefs about the same behaviour). To clarify more, a person may believe that the referral of patients with back pain will assure the patients and also that an x-ray will expose these patients to unnecessary radiation. A GP may be highly motivated to comply with the expectations of professional colleagues but not at all motivated to comply with the expectations of patients. Consequently, the removal of some of these beliefs from the

overall measures on the basis of low or negative correlations is not logical (Francis et al., 2004; Ajzen, 2006). As a result, test-retest reliability which is sometimes referred to a temporal stability was used to measure the reliability of indirect measure of the MRQ constructs (table 4.14). Test-retest reliability examined the ability of the indirect measures of the MRQ items to produce consistent results when the same MRQ items were tested at two different points of time (the time interval was at least two weeks) by a administering the MRQ to the same participant twice. Only 24 (52%) participants completed the MRQ twice (i.e. for the first time T1 and after two weeks T2) out of 46 who were invited to do so via the University email system.

Of the total 28 MRQ items of the indirect measures, 22 had correlations that met the threshold for reliability (> 0.5). The Pearson correlation of the remaining 6 MRQ items (normative belief item number 1 and 2, motivation to comply item number 1 and 2, control belief item number 5 and power of control factor item number 5) was < 0.5. The low correlation of these items may affect the reliability of these items to capture people's belief about reusing medicines. This provided the rationale for removing some of the questions as described in the results section.

**Table 5.14. Test re-test reliability of the indirect measures of the MRQ items (Pearson correlation)**

| MRQ Item | Pearson correlation |
|---|---|
| Behavioural Belief 1 (I think for me to contribute toward reducing the harmful effects of medication on the environment is) | 0.622 |
| Behavioural Belief 2 (I think for me to contribute toward reducing the NHS drug expenditure is) | 0.579 |
| Behavioural Belief 3 (I think for me to receive low quality medication is) | 0.686 |
| Behavioural Belief 4 (I think for me to receive unsafe medication is | 0.649 |
| Behavioural Belief 5 (I think for me to receive incorrect medication is) | 0.750 |
| Outcome evaluation 1 (Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment) | 0.523 |
| Outcome evaluation 2 (Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure) | 0.642 |
| Outcome evaluation 3 (Reusing sealed, returned blister-pack medication will result in me receiving low quality medication) | 0.540 |
| Outcome evaluation 4 (Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication) | 0.685 |
| Outcome evaluation 5 (Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication) | 0.506 |
| Normative belief 1 (Environmentalists would believe that I should reuse sealed, returned blister-pack medication) | 0.216 |
| Normative belief 2 (The pharmaceutical industry would believe that I should reuse sealed, returned blister-pack medication) | 0.438 |
| Normative belief 3 (My close friends would believe that I should reuse sealed, returned blister-pack medication) | 0.663 |
| Normative belief 4 (My family would believe that I should reuse sealed, returned blister-pack medication) | 0.533 |

| MRQ Item | Pearson correlation |
|---|---|
| Motivation to comply1 (Generally speaking, how much do you want to do what environmentalists believe you should do?) | 0.388 |
| Motivation to comply 2 (Generally speaking, how much do you want to do what the pharmaceutical industry believes you should do?) | 0.381 |
| Motivation to comply 3 (Generally speaking, how much do you want to do what your close friends believe you should do?) | 0.571 |
| Motivation to comply 4 (Generally speaking, how much do you want to do what your family believes you should do?) | 0.517 |
| Control belief 1 (I expect that any medication offered to me for reuse will be in the original, sealed, blister packaging) | 0.624 |
| Control belief 2 (I expect to see evidence that any medication offered to me for reuse would have been quality-checked) | 0.586 |
| Control belief 3 (I expect to see evidence that any medication offered to me for reuse would have been safety-checked) | 0.596 |
| Control belief 4 (I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining) | 0.539 |
| Control belief 5 (I expect to be offered some form of reward for reusing medication) | 0.419 |
| Power of control factor 1 (It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister packaging) | 0.579 |
| Power of control factor 2 (It would make it easier for me to reuse medication if I could see that it had been quality-checked) | 0.530 |
| Power of control factor 3 (It would make it easier for me to reuse medication if I could see that it had been safety-checked) | 0.558 |
| Power of control factor 4 (It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining) | 0.516 |

| MRQ Item | Pearson correlation |
|---|---|
| Power of control factor 5 (It would make it easier for me to reuse medication if I were offered some form of reward) | 0.480 |

## 5.7 Results summary

The MRQ items were developed following the standard construction procedures described by the Ajzen (2006) and Francis et al. (2004) guidelines. These procedures briefly required first an elicitation study to define the behaviour (i.e. medicines reuse) and population of interest, and to develop the items of indirect measures of TPB (refer to Chapter 4). Then, items of the direct measures of TPB, and the background factors that are related to medicines reuse behaviour were also developed. Standard scaling procedures were applied using a 7 point Likert scale for both direct and indirect measure items and a multiple choice format for background factor items. The item endpoints of the 7 point Likert scale included a mix of positive and negative end points. The first MRQ draft was developed and composed of 50 items. This draft was piloted and subjected to validity and reliability tests. These tests included content validity (which was explored by cognitive interviewing of 11 participant's and before administering the MRQ). Then, MRQ was administered to 46 participants and further testing was applied (CFA, alpha coefficient and Pearson correlation).

As a result of the piloting of the draft MRQ, two items were deleted from the MRQ and not replaced. These items were from indirect measures and relating to providing a rewarding system that may encourage people to reuse medicines in the future (i.e. control factor item;

I expect to be offered some form of reward for reusing medication, and power of control factor item; It would make it easier for me to reuse medication if I were offered some form of reward). The deletion of these items was based on results from CFA where the factor loading was very low (0.026) and test re-test reliability (Pearson correlation) was below 0.5. Moreover, some participants commented that the reward system is not affecting their decision to reuse medicine or not.

Four items from indirect measures were deleted but replaced and reworded. Those items were 2 normative belief items (environmentalists would believe that I should reuse sealed, returned blister-pack medication, and the pharmaceutical industry would believe that I should reuse sealed, returned blister-pack medication), and 2 motivation to comply items (generally speaking, how much do you want to do what environmentalists believe you should do?, and generally speaking, how much do you want to do what the pharmaceutical industry believes you should do?). The deletion of these items was based on results from CFA where the factor loading was low (0.358 and 0.356, respectively) and test re-test reliability (Pearson correlation) was below 0.5. These deleted items were from indirect measures, which means it was developed from the elicitation study. Therefore, it was important to contact our expert panel from the elicitation study and asked their opinion (who signed a consent form and agreed to be further contacted) before replacing these four items.

As result, an email was sent to them with a question asking about other people who may influence their decision to reuse medicines other than environmentalist and people from the pharmaceutical industry. The reply came from 10 participants out of 19 who commented that pharmacist and doctors would affect their decisions. As a  results, the deleted items

were replaced by four items; 2 normative belief item items (my doctor would believe that I should reuse sealed, returned blister-pack medication, and my pharmacist would believe that I should reuse sealed, returned blister-pack medication), and 2 motivation to comply items (generally speaking, how much do you want to do what your doctor believes you should do?, and generally speaking, how much do you want to do what your pharmacist believes you should do?).

One item from subjective norm (I would feel under social pressure to reuse medication in the future) was reworded into most people whose opinions I value, would approve of my decision to reuse medication in the future as the factor loading was low. Finally, two items from PBC construct (the decision to reuse medication in the future is beyond my control, and whether I reuse medication or not in the future is entirely up to me) were also reworded into the decision to reuse medication in the future is within my control, and whether or not I reuse medication in the future is completely up to me as their factor loadings were below 0.5. Although the factor loadings were very low for these two items, it was decided to reword these items and give them another chance instead of only deleting them at this stage as these items were measuring the controllability of the behaviour. Therefore, it was important to make sure that the very low factor loading is not due to poor construction or wording of these two items.

Based on the results of the piloting and refinement processes described above, the second draft (v2) of the MRQ (Appendix 11) was developed. The second draft MRQ was composed of 48 items and underwent further piloting by sending the MRQ to another 46 participants and the data analysed using CFA, and internal consistency (direct measures and intention construct) in order to ensure that the newly developed or reworded items

were valid. The result of the second piloting based on the factor loading from CFA indirect and direct measures (Table 5.15 and Table 5.16, respectively), showed good factor for loading with the exception of two items from PBC construct which measure the controllability of medicines reuse behaviour. The factor loadings for those two items was low and negatively loaded as well. Moreover, internal consistency of the PBC was also below 0.5. Those two items were measuring the controllability of the medicines reuse behaviour and were given a chance in the first piloting by rewording them, but were deleted in the second piloting. Therefore, the remaining PBC items included in third version of MRQ measured only self-efficacy of the medicines reuse behaviour.

**Table 5.15 Showed factor loading of the indirect measures of the second MRQ version**

| MRQ items (indirect measures) | Construct | Factor loading |
|---|---|---|
| I think for me to contribute toward reducing the harmful effects of medication on the environment is **x** Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment | Behavioural belief | 0.525 |
| I think for me to contribute toward reducing the NHS drug expenditure is **x** Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure | Behavioural belief | 0.569 |
| I think for me to receive low quality medication is **x** Reusing sealed, returned blister-pack medication will result in me receiving low quality medication | Behavioural belief | 0.777 |
| I think for me to receive unsafe medication is **x** Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication | Behavioural belief | 0.957 |

| MRQ items (indirect measures) | Construct | Factor loading |
|---|---|---|
| I think for me to receive incorrect medication is **x** Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication | Behavioural belief | 0.913 |
| My doctor would believe that I should reuse sealed, returned blister-pack medication **x** Generally speaking, how much do you want to do what your doctor believes you should do? | Normative belief | 0.796 |
| My pharmacist would believe that I should reuse sealed, returned blister-pack medication **x** Generally speaking, how much do you want to do what your pharmacist believes you should do? | Normative belief | 0.843 |
| My close friends would believe that I should reuse sealed, returned blister-pack medication **x** Generally speaking, how much do you want to do what close friends believe you should do? | Normative belief | 0.618 |
| My family would believe that I should reuse sealed, returned blister-pack medication **x** Generally speaking, how much do you want to do what your family believes you should do? | Normative belief | 0.623 |
| I expect that any medication offered to me for reuse will be in the original, sealed, blister-packaging **x** It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister-packaging | Control belief | 0.729 |
| I expect to see evidence that any medication offered to me for reuse would have been quality-checked **x** It would make it easier for me to reuse medication if I could see that it had been quality-checked | Control belief | 0.957 |
| I expect to see evidence that any medication offered to me for reuse would have been safety-checked **x** It would make | Control belief | 0.976 |

| MRQ items (indirect measures) | Construct | Factor loading |
|---|---|---|
| it easier for me to reuse medication if I could see that it had been safety-checked | | |
| I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining **x** It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining | Control belief | 0.763 |

**Table 5.16 Showed factor loading of the direct measures and intention of the second MRQ version**

| MRQ items (direct measures and intention) | Construct | Factor loading |
|---|---|---|
| Reusing medication in the future is *Harmful 1 2 3 4 5 6 7 beneficial* | Attitude | 0.934 |
| Reusing medication in the future is *good 1 2 3 4 5 6 7 bad* | Attitude | 0.938 |
| Reusing medication in the future is *satisfying (for me) 1 2 3 4 5 6 7 dissatisfying (for me)* | Attitude | 0.845 |
| Reusing medication in the future is *worthless 1 2 3 4 5 6 7 worthwhile* | Attitude | 0.956 |
| Most people whose opinions I value, would approve of my decision to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Subjective norm | 0.759 |
| Most people who are important to me would want me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Subjective norm | 0.914 |
| It would be expected of me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Subjective norm | 0.769 |
| Most people who are important to me would think that ---------- reuse medication in the future *I should 1 2 3 4 5 6 7 I should not* | Subjective norm | 0.572 |
| I am confident that I could reuse medication in the future if I wanted to *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Perceived behavioural control | 0.943 |
| For me to reuse medication in the future is *possible 1 2 3 4 5 6 7 impossible* | Perceived behavioural control | 0.714 |

| MRQ items (direct measures and intention) | Construct | Factor loading |
|---|---|---|
| The decision to reuse medication in the future is within my control *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Perceived behavioural control | -0.068 |
| Whether or not I reuse medication in the future is completely up to me *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Perceived behavioural control | -0.052 |
| I expect to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Intention | 0.949 |
| I want to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Intention | 0.956 |
| I intend to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* | Intention | 0.895 |

The alpha (α) coefficient values were consistent and actually improved compared to the previous piloting (Table 5.17). The alpha (α) coefficient value of the direct measures and intention construct was 0.931 in the second piloting which showed an improvement in term of internal consistency between the items in the direct measures and intention construct compared to the previous piloting (0.904). The internal consistency of attitude slightly improved as the alpha (α) coefficient values slightly increased from 0.935 in the first piloting to 0.954 in the second piloting. The subjective norm and the PBC internal consistency showed an improvement as the alpha (α) coefficient values of the subjective norm increased from 0.706 in the first piloting to 0.818 in the second piloting and alpha (α) coefficient values of PBC increased from 0.303 in the first piloting to 0.425 in the second piloting. However, the alpha (α) coefficient values of PBC is far from the acceptable value.

Hence two PBC items that measured controllability of reusing medicines were deleted. The intention construct internal consistency was the same as the alpha (α) coefficient value in the first piloting.

**Table 5.17 Alpha (α) coefficient values of the direct measure and intention construct of the second MRQ version**

| TPB construct | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|---|
| Direct measures construct and intention | 0.931 | 0.930 | 15 |
| Attitude | 0.954 | 0.956 | 4 |
| Subjective norm | 0.818 | 0.820 | 4 |
| **Perceived behavioural control (PBC)** | **0.425** | **0.425** | 4 |
| Intention | 0.953 | 0.954 | 3 |

The third version (v3) of the MRQ were composed of 46 items (Appendix 12) and was ready to be used to capture national views, beliefs and willingness of people to reuse medicines in the future.

## 5.8 Discussion

This chapter described phase 2 of the larger study the results of which are briefly summarised here. Starting from the elicitation of salient beliefs, this work progressed to the wording, formatting, and development of a reliable and valid MRQ items. The TPB framework was used as a tool to construct the MRQ items. The results from the validity and reliability testing were used to standardise the MRQ and showed that the MRQ is both valid and reliable. The final version of the MRQ has been therefore shown to be a stable

and accurate tool to capture wider, representative views of people's beliefs and attitudes toward the reuse of medicines in the future. The results from the validity and reliability testing, and the refinement of the MRQ items which required two piloting phases ensured that the final version of the MRQ is considered robust enough to predict the intention to reuse medicines in the future. The development of a robust MRQ was considered a vital step before disseminating the MRQ nationwide.

A recent systematic review evaluating the quality assessment of TPB-based questionnaire by Oluka et al. (2014) highlighted the top problems associated with the development of TPB-based questionnaire. The areas of problems were related to sample size estimation, the inclusion of both direct and indirect measures of TPB, inclusion of background factors related to the behaviour, and finally whether the researcher provided more information about the questionnaire development process. In this research, the development of the MRQ followed step by step guidelines of constructing TPB-based questionnaire as recommended by Ajzen (2006) and Francis et al. (2004). To clarify more, the final version of the MRQ was carefully developed and included both indirect (from the elicitation study) and direct measure items, background factor items that are related to medicines reuse as a behaviour. In addition, all the development and construction procedures, validity and reliability tests were clearly described in this chapter. Finally, the MRQ was disseminated to large sample size of about 1000 which is above the required sample for TBP-based questionnaire (more than 80) as recommended by Francis et al. (2004) – this is the subject of the next chapter.

Therefore, there were no limitations or problems associated with the design, validity and reliability of the MRQ in this research. Moreover, and comparing to the quality assessment

of TBP-based questionnaire (Oluka et al., 2014), and the standard procedures recommended by Ajzen (2006) and Francis et al. (2004), there was nothing that could be done differently regarding the construction, validity, and reliability testing of the MRQ. Therefore the next phase (i.e. phase 3) of this study focussed on the dissemination of the MRQ and the utility of the TPB in predicting people's beliefs and intentions to reuse medicines in the future, described in the next chapter.

## 5.9 Conclusion

The final version of the MRQ underwent two piloting phases in which items were deleted, refined and reworded. The piloting process involved validity and reliability testing until the MRQ items became consistent, accurate, and valid and there were no limitations or problems associated with the design, validity and reliability of the MRQ in this research. Therefore, a stable and accurate MRQ questionnaire was developed and ready for dissemination to measure people's (i.e. from respondents drawn from around the UK) belief and willingness to reuse medicines in the future .

# Chapter 6 PUBLIC PERCEPTIONS ABOUT MEDICINES REUSE – RESPONDENTS DRAWN FROM AROUND THE UK

## 6.1 Introduction

Following the elicitation study (detailed in Chapter 4), MRQ items were created, reviewed and underwent validity and reliability testing (detailed in Chapter 5). The final version of the MRQ was made available online using the Qualtrics online platform. Qualtrics is a simple yet sophisticated online survey platform which allowed the creation and distribution of the final version of the MRQ. An online panel was used to recruit participants in collaboration with a market research panel company called Research Now®. Online panels are a group of selected and pre-screened research paid participants who have agreed to provide information at specified intervals over an extended period of time. Research Now® has more than 11 million panel members in more than 40 countries including the UK. It helped with panel recruitment and ensured the participants were relevant respondents, who could provide real, relevant insight. Moreover, Research Now® was able to provide a panel list that is in line with targeted sampling to ensure representation from different regions in the UK. This was confirmed by a adding a screen out question: 'we are interested in the views of people with a long term health condition only, do you currently have a long term health condition? yes, no' as well as adding a background item 'in which region of the UK do you currently live', respectively – the latter allowed the researcher to monitor completions and ensure representations spread across the regions of the UK.

Before online recruitment started, the final version of the MRQ was reviewed. The review process included:

a) Inclusion of clarification statements which were added before each MRQ item. For example,
    a. *complete the following sentence*: reusing medicine in the future is good 1 2 3 4 5 6 7 bad,
    b. *How far do you agree the following statement*: most people whose opinions I value, would approve if I decided to reuse medication in the future strongly disagree 1 2 3 4 5 6 7 strongly agree,
    c. *Answer the following question*: generally speaking, how much do you want to do what your family believes you should do?
    d. *Do you agree with the following statement*: I expect that any medication offered to me for reuse will be in the original, sealed, blister packaging.
b) Three items were added to the MRQ. Those items were;
    a. We are interested in the views of people with a long term health condition only, do you currently have a long term health condition?
    b. Which of the following (or another) long term health condition(s) do you have,
    c. In which region of the UK do you currently live?
c) It was decided to delete the question asking about the religion of the participants as this was considered a sensitive question and ultimately it was difficult to justify its inclusion.

After the review, the MRQ that was distributed (v4) composed of 48 items (Appendix 13) and was ready to be disseminated nationwide to capture people's beliefs and intentions to reuse medicine in the future.

## 6.2 Aims and objectives

The aim of phase 3 of the study was to:

a) Conduct a nationwide survey of people's beliefs and intentions to take part in medicines reuse in the future.

The objectives of phase 3 described in this chapter were to:

a) Disseminate the MRQ via a market research company (Research Now®) to quantify views about medicines reuse of a cross section of 1,000 patients living in the UK.
b) Evaluate the predictive utility of TPB in understanding people's attitudes and intentions to reuse medicines in the future.

## 6.3 Methodology

An amendment to ethical application (reference number 30/15) was submitted to the University Reading's Research Ethics Committee and was approved on 10/02/2017. The amendment contained information an online recruitment using Market Research Company, online panel and online platform. Participants from an online panel were recruited using targeted sampling technique targeting only participants with a long-term condition and screening out those not having chronic conditions. Sampling was aimed to be UK representative by recruiting participants from different regions in the UK, and across the different age groups and genders.

The required sample size for TPB studies using multiple regression analysis is generally accepted to have at least 80 participants (Francis et al., 2004). However, the definitive sample size that is required for TPB studies using SEM analysis is not straightforward and

depend on the model complexity and the relationships among variables in the model (Stevens, 2012). Generally, the recommended sample is of at least 200 to be used for SEM analysis (Kline, 2011; Stevens, 2012). The sample size was not an issue in this study as 1,003 usable responses were obtained.

The intended sample size was divided into participants with long-term conditions who were using medicines (n=800), or not currently using medicines but used in the past (n=100), or had never taken any medicines for their long-term condition (n=100). The majority of the sample size was therefore targeting people with a long term condition who were using medicines as those people will be reasonable expected to reuse medicine in the future if medicines reuse became a reality. However, it was important not to miss the viewpoints of people who have long term condition and are not currently using medicines (10% of the sample size), or people who have long term condition and had never taken any medicines for their long-term condition (10% of the sample size), as those may require medicines for their long term condition in the future.

A soft launch (10% of the total sample, n = 100) of the MRQ was undertaken to review and quality-check data before the full launch in September 2017. Data obtained during soft launch (i.e. internal piloting) were included in the main study analysis. During data collection, the representativeness of the sample was monitored for geographical spread, age groups and gender balance but no adjustment to the recruitment strategy was found to be necessary. Ethical approval for this element of the study was obtained via the in-school exemption process. Descriptive analysis was completed with the anonymised dataset using SPSS (V23).

The main analysis of direct and indirect measures of TPB were by using multiple linear regression procedures and SPSS (V23), with preliminary analysis performed to ensure that there was no violation of the assumption on normality, linearity, and multicollinearity. Multiple linear regression procedure were performed on the data using SPSS (V23) to predict people's intentions to reuse medicine in the future based upon their attitude, social pressure (subjective norm), and PBC to reuse medicines Simple linear regression procedure were also performed on the data using SPSS (V23) to predict people's attitude to reusing medicines in the future based on their behavioural beliefs, subjective norms based on their normative beliefs, and PBC based on their control beliefs.

Although the multiple linear regression procedures was useful in indicating a certain degree of relationship between the independent (predictor) variable and the dependent (outcome) variable when used to predict intention to reuse medicines in the future, it is never clear to what extent the observed relationship has been reduced by poor measurement of the variables in the analysis. In order to avoid this (i.e. the interpretation problems encountered in or associated with multiple regression), the Structural Equation Modelling (SEM) with the standardised path coefficient was applied using AMOS SPSS to test the various hypotheses in this study. The reason for applying SEM is that it allowed for variables to correlate (while multiple regression adjusts for variables in the model). In addition, SEM accounted for measurement error (while multiple regression assumes perfect measurement). Finally, SEM was used to assess the TPB model fit.

Therefore, hypothesis testing was performed using SEM with standardized path coefficients, and several common model-fit measures were checked to assess the model's overall goodness-of-fit using AMOS SPSS. These tests included chi-square, Root Mean

Square Error of Approximation (RMSEA) Normalized Fit Index (NFI), Tucker Lewis Index (TLI) and the Comparative Fit Index (CFI).

## 6.4 Results

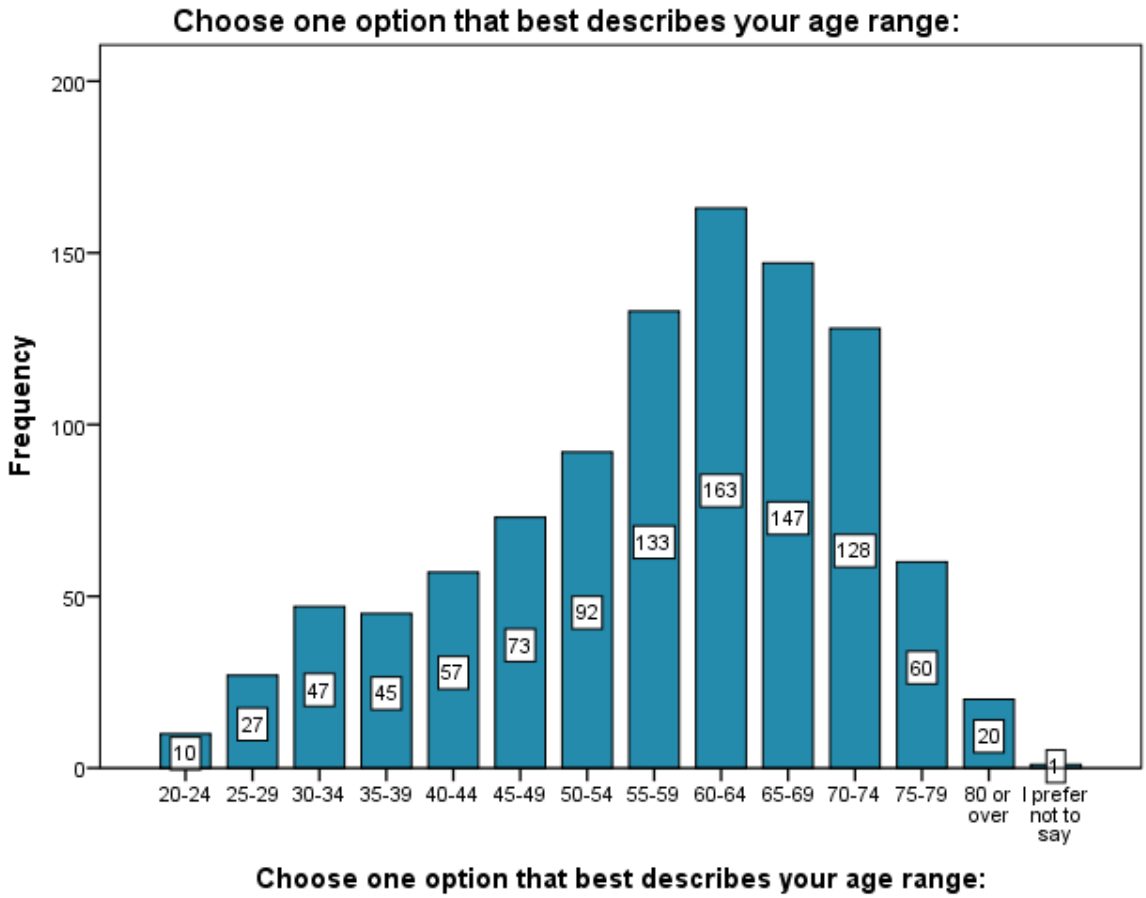
### 6.4.1 Descriptive statistics

A total of 1,181 people were invited to complete the questionnaire, with 178 excluded because they reported to not having a long-term condition, resulting in 1,003 relevant responses. Descriptive analysis was performed to illustrate the findings from the MRQ items. The background factors items and items of the direct and indirect measures of TPB are described below in sequence.

#### *6.4.1.1 Background factors*

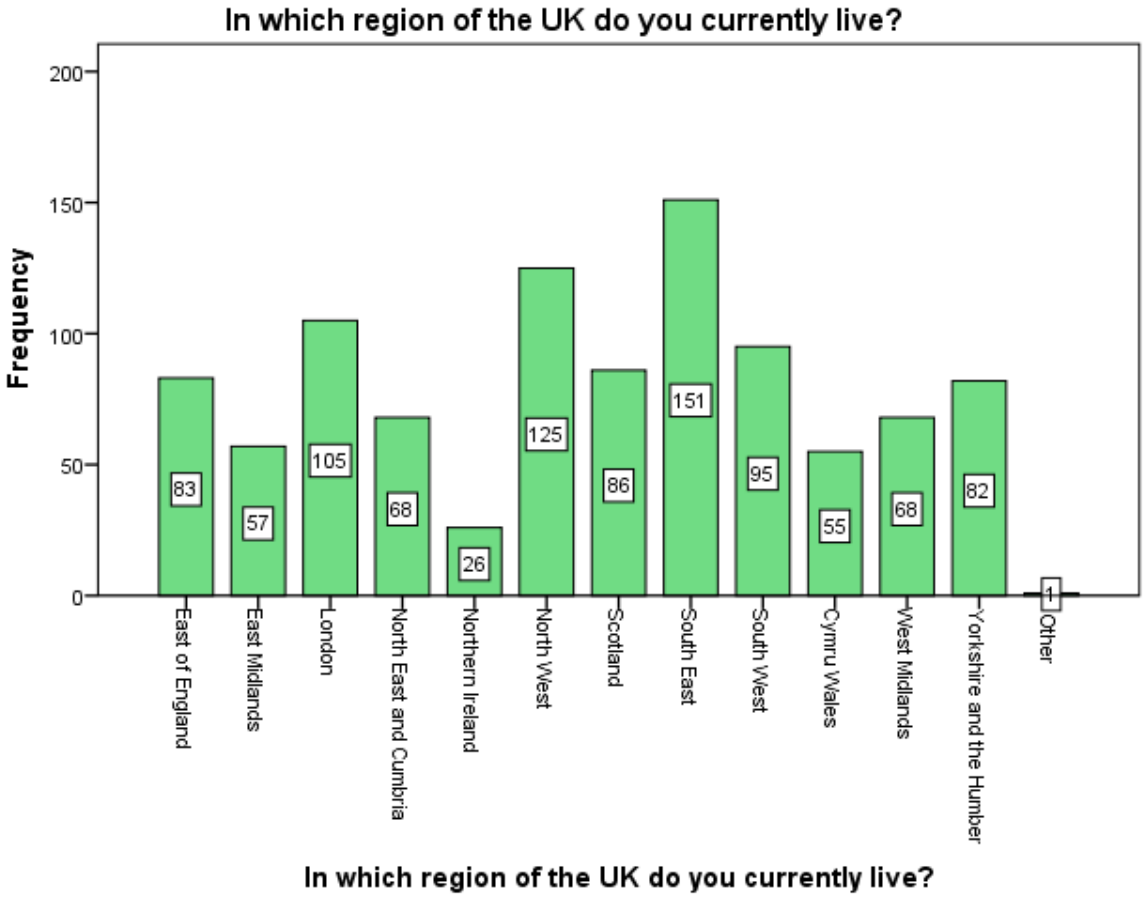
Gender and ethnicity of the participants were in line with UK population census data, as 51 % (n = 509) were female, 49% (n = 494) were male, and the majority of the participants reported their ethnicity as white British 92% (n = 927). Participant's age range of 60 to 64 was the highest 16 % (n = 163), and the lowest 1% (n=10) was for the age range 20 to 24. In addition, the participant's age ranges 65 to 69 constituted 15% (n = 147) of the sample, 55 to 59 was 13% (n = 133), and 70 to74 was 13% (n = 128) (Figure 6.1). Forty one percent (n=412) of the participant's reported to have some form of higher education, while 59% (n=591) reported to have an A level or below (Table 6.1).

**Figure 6.1 The frequency of participant's responses according to their age ranges**



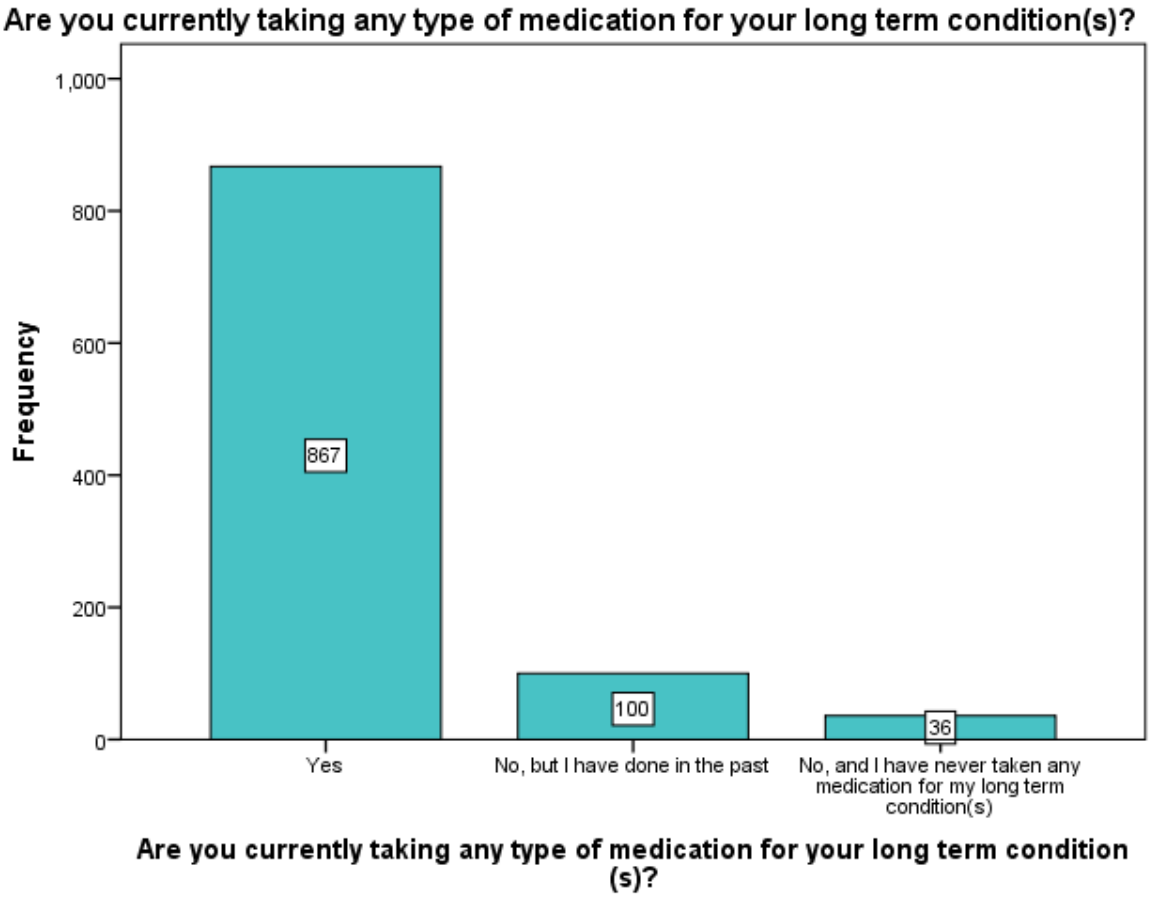

The participants responses were highest from South East (n = 151), and lowest from Northern Ireland (n = 26) areas in the UK. The participant responses according to the geographical areas from the UK are presented in Figure 6.2.

**Figure 6.2 The frequency of participant's responses according to the geographical areas of living**




The majority of the participants are taking medicines for their long term condition (86.4%) (n = 867), 10% (n = 100) are not currently taking medicines but did take medicines in the past, and only 3.6% (n = 36) are not currently taking medicines and have never taking any medicines for their long term conditions (Figure 6.3).

**Figure 6.3 The number of participant's responses according to whether are taking medicines for their long term conditions or have done in the past**




A summary of the background factors including gender, age, ethnicity, educational level, participant's geographical areas of living in the UK, and if participants are taking medicines for their long term conditions are all shown in Table 6.1.

## Table 6.1 Summary of the background factors

| Variable | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 494 | 49.3% |
| Female | 509 | 50.7% |
| **Age** | | |
| 20-24 | 10 | 1% |
| 25-29 | 27 | 2.7% |
| 30-34 | 47 | 4.7 |
| 35-39 | 45 | 4.5% |
| 40-44 | 57 | 5.7% |
| 45-49 | 73 | 7.3% |
| 50-54 | 92 | 9.2% |
| 55-59 | 133 | 13.3% |
| 60-64 | 163 | 16.3% |
| 65-69 | 147 | 14.7% |
| 70-74 | 128 | 12.8% |
| 75-79 | 60 | 6.0% |
| 80 or over | 20 | 2.0% |
| I prefer not to say | 1 | 0.1% |
| **Ethnicity** | | |
| White (English / Welsh / Scottish / Northern Irish/British) | 927 | 92.4% |
| White (Irish) | 14 | 1.4% |
| White (Gypsy or Irish Traveller) | 2 | 0.2% |
| Any other White background | 19 | 1.9% |
| Mixed / Multiple ethnic groups (White and Black Caribbean) | 3 | 0.3% |
| Mixed / Multiple ethnic groups (White and Black African) | 1 | 0.1% |
| Mixed / Multiple ethnic groups (White and Asian) | 5 | 0.5% |
| Any other Mixed / Multiple ethnic background | 2 | 0.2% |
| Asian / Asian British (Indian) | 10 | 1% |

| Variable | Frequency | Percentage |
|---|---|---|
| Asian / Asian British (Pakistani) | 3 | 0.3% |
| Asian / Asian British (Bangladeshi) | 3 | 0.3% |
| Asian / Asian British (Chinese) | 1 | 0.1% |
| Any other Asian background | 2 | 0.2% |
| Black / Black British (African) | 3 | 0.3% |
| Black / Black British (Caribbean) | 4 | 0.4% |
| Arab | 2 | 0.2% |
| Other | 1 | 0.1% |
| I prefer not to say | 1 | 0.1% |
| **Educational level** | | |
| University Higher Degree (e.g. MSc, PhD) | 117 | 11.7% |
| First degree level qualification including foundation degrees, graduate membership of a professional Institute, PGCE | 179 | 17.8% |
| Diploma in higher education | 74 | 7.4% |
| Teaching qualification (excluding PGCE) | 20 | 2.0% |
| Nursing or other medical qualification not yet mentioned | 22 | 2.2% |
| A Level | 129 | 12.9% |
| Welsh Baccalaureate | 1 | 0.1% |
| International Baccalaureate | 5 | 0.5% |
| AS Level | 17 | 1.7% |
| Higher Grade/Advanced Higher (Scotland) | 21 | 2.1% |
| Certificate of sixth year studies | 7 | 0.7% |
| GCSE/O Level | 235 | 23.4% |
| CSE | 40 | 4% |
| Standard/Ordinary (O) Grade / Lower (Scotland) | 37 | 3.7% |
| Other school (including school leaving exam certificate or matriculation) | 32 | 3.2% |
| I prefer not to say | 27 | 2.7% |
| Other | 40 | 4% |

| Variable | Frequency | Percentage |
|---|---|---|
| **Geographical areas** | | |
| East of England | 83 | 8.3% |
| East Midlands | 57 | 5.7% |
| London | 105 | 10.5% |
| North East and Cumbria | 68 | 6.8% |
| Northern Ireland | 26 | 2.6% |
| North West | 125 | 12.5% |
| Scotland | 86 | 8.6% |
| South East | 151 | 15.1% |
| South West | 95 | 9.5 % |
| Cymru Wales | 55 | 5.5% |
| West Midlands | 68 | 6.8% |
| Yorkshire and the Humber | 82 | 8.2% |
| Other | 1 | 0.1% |
| **Are you currently taking any type of medicines for your long term conditions?** | | |
| Yes | 867 | 86.4% |
| No, but I have done in the past | 100 | 10% |
| No, and I have never taken any medication for my long term condition(s) | 36 | 3.6% |

### *6.4.1.2 Theory of planned behaviour constructs*

Descriptive analysis was performed for the final version of the MRQ items. The analysis of the intention, direct, and indirect measures of TPB are detailed below.

#### 6.4.1.2.1 *Intention*

Intention was measured using three items listed here with mean and standard deviation (SD) values, namely:

- I expect to reuse medication in the future (disagree or agree). Mean 4.67, SD 1.90.
- I want to reuse medication in the future (disagree or agree). Mean 4.69, SD 1.98.
- I intend to reuse medication in the future (disagree or agree). Mean 4.65, SD 1.90.

Five hundred and seventy (56.8%) of the participants indicated that they were expecting themselves to reuse medicines in the future [i.e. chose 7 'strongly agree', or 6 or 5, which also indicate some degree of agreement], while 245 (23.5%) of the participants indicated that they were not expecting themselves to reuse medicines in the future [i.e. chose 1 'strongly disagree', or 2 or 3, which also indicate some degree of disagreement], and 198 (19.7%) were neutral on this response. In addition, 567 (56.5%) agreed that they want to reuse medicines in the future, while 237 (23.7%) did not agree that they want to reuse medicines in the future, and 199 (19.8%) gave a neutral response. Finally, 547 (54.5%) respondents intended to reuse medicines in the future, 226 (22.6%) did not intend to reuse medicines in the future and 230 (22.9%) were neutral (see Table 6.2).

## Table 6.2 Mean and frequency of distributions of intention items

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Strongly disagree | | | Neither disagree nor agree | | | Strongly agree |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I expect to reuse medication in the future | 4.67 (1.90) | 102 (10.2%) | 67 (6.7%) | 66 (6.6%) | 198 (19.7%) | 164(16.4%) | 204(20.3%) | 202 (20.1%) |
| I want to reuse medication in the future | 4.69 (1.98) | 116 (11.6%) | 67 (6.7%) | 54 (5.4%) | 199 (19.8%) | 147(14.7%) | 177(17.6%) | 243 (24.2%) |
| I intend to reuse medication in the future | 4.65 (1.90) | 106 (10.6%) | 60 (6%) | 60 (6%) | 230 (22.9%) | 157(15.7%) | 178(17.7%) | 212 (21.1%) |

#### 6.4.1.2.2 *Attitude (direct and indirect) measures*

The *direct* measure of attitude was obtained using four items listed with mean and standard deviation (SD) values, namely:

- Reusing medication in the future would be (harmful or beneficial). Mean 4.60, SD 2.03.
- Reusing medication in the future would be (good or bad). Mean 4.69, SD 2.03.
- Reusing medication in the future would be (satisfying or dissatisfying). Mean 4.56, SD 1.95.
- Reusing medication in the future would be (worthless or worthwhile). Mean 4.87, SD 1.97.

Five hundred and forty two (54.1%) of the participants indicated that reusing medicines in the future would be beneficial, while 260 (26%) of the participants indicated that reusing medicines in the future would be harmful, and 201 (20%) were neutral on this response. In addition, 558 (55.7%) indicated that reusing medicines in the future would be good, while 258 (25.8%) indicated that reusing medicines in the future would be bad, and 187 (18.6%) gave a neutral response. Five hundred (49.9%) respondents indicated that reusing medicines in the future would be satisfying process for them, 251 (25.1%) indicated that reusing medicines in the future would be dissatisfying process for them and 252 (25.1%) were neutral. Finally, 595 (59.4%) respondents indicated that reusing medicines in the future would be worthwhile for them, 215 (21.5%) indicated that reusing medicines in the future would be worthless for them for them and 193 (19.2%) were neutral (Table 6.3).

**Table 6.3 Mean and frequency of distributions of direct attitude items**

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Harmful** | | | **Neither harmful nor beneficial** | | | **Beneficial** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Reusing medication in the future would be [.....] | 4.60 (2.03) | 131 (13.1%) | 64 (6.4%) | 65 (6.5%) | 201 (20%) | 150 (15%) | 139 (13.9%) | 253 (25.2%) |
| | | **Good** | | | **Neither Good nor bad** | | | **Bad** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Reusing medication in the future would be [.....] | 4.69 (2.03) | 120 (12%) | 67 (6.7%) | 71 (7.1%) | 187 (18.6%) | 138 (13.8%) | 142 (14.2%) | 278 (27.7%) |
| | | **Satisfying for me** | | | **Neither satisfying nor dissatisfying** | | | **Dissatisfying for me** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Reusing medication in the future would be [.....] | 4.56 (1.95) | 115 (11.5%) | 62 (6.2%) | 74 (7.4%) | 252 (25.1%) | 121 (12.1%) | 148 (14.8%) | 231 (23%) |
| | | **Worthless** | | | **Neither worthless nor worthwhile** | | | **Worthwhile** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Reusing medication in the future would be [.....] | 4.87 1.97) | 106 (10.6%) | 52 (5.2%) | 57 (5.7%) | 193 (19.2%) | 135 (13.5%) | 166 (16.6%) | 294 (29.3%) |

The *indirect* measure of attitude (i.e. the behavioural beliefs and the outcome evaluation) was measured using ten items. The behaviour belief was measured using five items listed here with mean and standard deviation (SD) values, namely:

- I think for me to contribute toward reducing the harmful effects of medication on the environment is (good or bad). Mean 5.57, SD 1.48.
- I think for me to contribute toward reducing the amount of money spent by the NHS on medication is (good or bad). Mean 5.84, SD 1.43.
- I think for me to receive low quality medication is (good or bad). Mean 5.84, SD 1.63.
- I think for me to receive unsafe medication is (good or bad). Mean 6.40, SD 1.36.
- I think for me to receive incorrect medication is (good or bad). Mean 6.40, SD 1.46.

Seven hundred and forty one (73.9%) of the participants indicated that their contribution toward reducing the harmful effect of medicines in the environment would be good, while 68 (6.8%) of the participants indicated that their contribution toward reducing the harmful effect of medicines in the environment would be bad, and 194 (19.3%) were neutral on this response. In addition, 794 (79.2%) indicated that their contribution toward reducing the amount of money spent by the NHS on medicines would be good, while 56 (5.6%) indicated that their contribution toward reducing the amount of money spent by the NHS on medicines would be bad, and 153 (15.3%) gave a neutral response. One hundred and four (10.4%) respondents indicated that receiving low quality medicines is good, while 795 (79.2%) indicated that receiving low quality medicines is bad, and 104 (25.1%) were neutral. Moreover, sixty five (6.5%) respondents indicated that receiving unsafe medicines

is good, while 886 (88.4%) indicated that receiving unsafe medicines is bad, and 52 (5.2%) were neutral. Finally, 73 (7.3%) respondents indicated that receiving incorrect medicines is good, 883 (88.1%) indicated that receiving incorrect medicines is bad, and 47 (4.7%) were neutral (Table 6.4).

The outcomes evaluation was measured using five items listed here with mean and standard deviation (SD) values, namely:

- Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment (agree or disagree). Mean 5.47, SD 1.66.
- Reusing sealed, returned blister-pack medication will help me contribute toward reducing the amount of money spent by the NHS on medication (agree or disagree). Mean 5.75, SD 1.59.
- Reusing sealed, returned blister-pack medication is likely or unlikely to result in me receiving low quality medication. Mean 4.90, SD 1.84.
- Reusing sealed, returned blister-pack medication is likely or unlikely to result in me receiving unsafe medication. Mean 4.87, SD 1.88.
- Reusing sealed, returned blister-pack medication is likely or unlikely to result in me receiving incorrect medication. Mean 4.94, SD 1.88.

Seven hundred and thirty two (73%) of the participants agreed that reusing sealed blister pack medicines will help them contribute toward reducing the harmful effect of medicines in the environment, while 108 (10.8%) of the participants did not agree that reusing sealed blister pack medicines will help them contribute toward reducing the harmful effect of

medicines in the environment, and 163 (16.3%) were natural. Moreover, Seven hundred and eighty four (78.2%) of the participants agreed that reusing sealed blister pack medicines will help them contribute toward reducing the amount of money spent by the NHS on medicines, while 85 (8.5%) of the participants did not agree that reusing sealed blister pack medicines will help them contribute toward reducing the amount of money spent by the NHS on medicines, and 134 (13.4%) were neutral. Five hundred and seventy nine (57.7%) indicated that reusing sealed blister pack medicines is extremely likely to result in them receiving low quality medicine, while 205 (20.5%) indicated that reusing sealed blister pack medicines is extremely unlikely to result in them receiving low quality medicine. and 219 (21.8%) were neutral. Moreover, 575 (57.3%) indicated that reusing sealed blister pack medicines is extremely likely to result in them receiving unsafe medicine, while 220 (22%) indicated that reusing sealed blister pack medicines is extremely unlikely to result in them receiving unsafe medicine, and 208 (20.7%) were neutral. Finally, 603 (60.1%) indicated that reusing sealed blister pack medicines is extremely likely to result in them receiving incorrect medicine, while 215 (21.5%) indicated that reusing sealed blister pack medicines is extremely unlikely to result in them receiving incorrect medicine, and 184 (18.3%) were neutral (Table 6.4).

## Table 6.4 Mean and frequency of distributions of behavioural beliefs and outcome evaluation

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Extremely bad** | | | **Neither bad nor good** | | | **Extremely good** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I think for me to contribute toward reducing the harmful effects of medication on the environment is [.....] | 5.57 (1.48) | 20 (2%) | 20 (2%) | 28 (2.8%) | 194 (19.3%) | 160 (16%) | 202 (20.1%) | 379 (37.8%) |
| I think for me to contribute toward reducing the amount of money spent by the NHS on medication is [.....] | 5.84 (1.43) | 16 (1.6%) | 15 (1.5%) | 25 (2.5%) | 153 (15.3%) | 117 (11.7%) | 198 (19.7%) | 479 (47.8%) |
| I think for me to receive low quality medication is [.....] | 5.84 (1.63) | 534 (53.2%) | 180 (17.9%) | 81 (8.1%) | 104 (10.4%) | 40 (4%) | 32 (3.2%) | 32 (3.2%) |
| I think for me to receive unsafe medication is [.....] | 6.40 (1.36) | 775 (77.3%) | 91 (9.1%) | 20 (2%) | 52 (5.2%) | 27 (2.7%) | 19 (1.9%) | 19 (1.9%) |
| I think for me to receive incorrect medication is [.....] | 6.40 (1.46) | 813 (81.1%) | 55 (5.5%) | 15 (1.5%) | 47 (4.7%) | 20 (2%) | 23 (2.3%) | 30 (3%) |
| | | **Definitely disagree** | | | **Neither disagree nor agree** | | | **Definitely agree** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment | 5.47 (1.66) | 44 (4.4%) | 26 (2.6%) | 38 (3.8%) | 163 (16.3%) | 150 (15%) | 195 (19.4%) | 387 (38.6%) |
| Reusing sealed, returned blister-pack medication will help me contribute toward reducing the amount of money spent by the NHS on medication | 5.75 (1.59) | 34 (3.4%) | 21 (2.1%) | 30 (3%) | 134 (13.4%) | 123 (12.3%) | 180 (17.9%) | 481 (48%) |

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Extremely unlikely** | | | **Neither unlikely nor likely** | | | **Extremely likely** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Reusing sealed, returned blister-pack medication is [.....] to result in me receiving low quality medication | 4.90 (1.84) | 70 (7%) | 54 (5.4%) | 81 (8.1%) | 219 (21.8%) | 128 (12.8%) | 178 (17.7%) | 273 (27.2%) |
| Reusing sealed, returned blister-pack medication is [.....] to result in me receiving unsafe medication | 4.87 (1.88) | 76 (7.6%) | 60 (6%) | 84 (8.4%) | 208 (20.7%) | 113 (11.3%) | 191 (19%) | 271 (27%) |
| Reusing sealed, returned blister-pack medication is [.....] to result in me receiving incorrect medication | 4.94 (1.88) | 73 (7.3%) | 58 (5.8%) | 84 (8.4%) | 184 (18.3%) | 115 (11.5%) | 210 (20.9%) | 278 (27.7%) |

#### 6.4.1.2.3 *Subjective norm (direct and indirect) measures*

The *direct* measure of subjective norm was measured using four items namely with mean and standard deviation (SD) value:

- Most people whose opinions I value, would approve if I decided to reuse medication in the future (disagree or agree). Mean 4.64, SD 1.83.
- Most people who are important to me would want me to reuse medication in the future (disagree or agree). Mean 4.60, SD 1.85.
- I would be expected by others to reuse medication in the future (disagree or agree). Mean 4.30, SD 1.85.
- Most people who are important to me would think that I should or I should not reuse medication in the future. Mean 4.23, SD 1.98.

Five hundred and fifty six (55.3%) of the participants agreed that most people whose opinion they value would approve them if they decided to reuse medicines in the future, while 216 (21.5%) of the participants did not agree that most people whose opinion they value would approve them if they decided to reuse medicines in the future, and 231 (23%) were neutral. In addition, 544 (54.1%), of the participants agreed that most people who are important to them would want them to reuse medicines in the future, while 226 (22.6%) of the participants did not agree that most people who are important to them would want them to reuse medicines in the future, and 233 (23.2%) were neutral. Four hundred and fifty three (45.3%) of the participants agreed that they would be expected by others to medicines in the future, while 280 (28%) of the participants did not agree that they would be expected by others to medicines in the future, and 270 (26.9%) were neutral. Finally, 430 (42.9%) of the participants thought that most people who are important to them would think that they

should reuse medicines in the future, while 336 (33.6%) of the participants thought that most people who are important to them would think that they should not reuse medicines in the future, and 237 (23.6%) were neutral (Table 6.5).

**Table 6.5 Mean and frequency of distributions of direct measures of subjective norm**

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Strongly Disagree** | | | **Neither disagree nor agree** | | | **Strongly agree** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Most people whose opinions I value, would approve if I decided to reuse medication in the future | 4.64 (1.83) | 96 (9.5%) | 63 (6.3%) | 57 (5.7%) | 231 (23%) | 179 (17.8%) | 195 (19.4%) | 182 (18.1%) |
| Most people who are important to me would want me to reuse medication in the future. | 4.60 (1.85) | 100 (10%) | 70 (7%) | 56 (5.6%) | 233 (23.2%) | 174 (17.3%) | 186 (18.5%) | 184 (18.3%) |
| I would be expected by others to reuse medication in the future | 4.30 (1.85) | 121 (12.1%) | 77 (7.7%) | 82 (8.2%) | 270 (26.9%) | 153 (15.3%) | 155 (15.5%) | 145 (14.5%) |
| | | **I should** | | | **Neither I should or I should not** | | | **I should not** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Most people who are important to me would think that [.....] reuse medication in the future | 4.23 (1.98) | 130 (13%) | 100 (10%) | 106 (10.6%) | 237 (23.6%) | 115 (11.5%) | 128 (12.8%) | 187 (18.6%) |

The *indirect* measure of subjective norm (i.e. normative belief and motivation to comply) was measured using eight items. The normative beliefs were measured using four items listed here with mean and standard deviation (SD) values, namely:

- My doctor would believe that I should reuse sealed, returned blister-pack medication (agree or disagree). Mean 4.58, SD 1.67.
- My pharmacist would believe that I should reuse sealed, returned blister-pack medication (agree or disagree). Mean 4.58, SD 1.77.
- My close friends would believe that I should reuse sealed, returned blister-pack medication (agree or disagree). Mean 4.45, SD 1.79.
- My family would believe that I should reuse sealed, returned blister-pack medication (agree or disagree). Mean 4.48, SD 1.90.

Four hundred and fifty five (45.4%) of the participants agreed that their doctor would believe that they should reuse sealed, returned blister-pack medicines in the future, while 180 (18%) of the participants did not agree that their doctor would believe that they should reuse sealed, returned blister-pack medicines in the future, and 368 (37.7%) were neutral. In addition, 501 (49.9%) of the participants agreed that their pharmacist would believe that they should reuse sealed, returned blister-pack medicines in the future, while 208 (20.8%) of the participants did not agree that their pharmacist would believe that they should reuse sealed, returned blister-pack medicines in the future, and 293 (29.3%) were neutral. Four hundred and fifty seven (45.7%) of the participants agreed that their close friends would believe that they should reuse sealed, returned blister-pack medicines in the future, while 229 (22.9%) of the participants did not agree that their close friends would believe that they

should reuse sealed, returned blister-pack medicines in the future, and 317 (31.6%) were neutral. Finally, 497 (49.5%) of the participants agreed that their family would believe that they should reuse sealed, returned blister-pack medicines in the future, while 269 (26.9%) of the participants did not agree that their family would believe that they should reuse sealed, returned blister-pack medicines in the future, and 237 (23.6%) were neutral (table 5.6).

The motivation to comply was measured using four items listed here with mean and standard deviation (SD) values, namely:

- Generally speaking, how much do you want to do what your doctor believes you should do? Mean 5.55, SD 1.29.
- Generally speaking, how much do you want to do what your pharmacist believes you should do? Mean 5.22, SD 1.36.
- Generally speaking, how much do you want to do what your close friends believes you should do? Mean 4.40, SD 1.54.
- Generally speaking, how much do you want to do what your family believes you should do? Mean 4.94, SD 1.48.

Seven hundred and seventy eight (77.5%) of the participants generally agreed that they wanted to do what their doctor believes they should do, while 54 (5.4%) of the participants generally disagreed that they wanted to do what their doctor believes they should do, and 171 (17%) were neutral. In addition, 687 (68.4%) of the participants generally agreed that they wanted to do what their pharmacist believes they should do, while 87 (8.7%) of the participants generally disagreed that they wanted to do what their pharmacist believes they

should do, and 229 (22.8%) were neutral. Four hundred and forty four (44.3%) of the participants generally agreed that they wanted to do what their close friends believe they should do, while 216 (21.6%) of the participants generally disagreed that they wanted to do what their close friends believe they should do, and 343 (34.2%) were neutral. Finally, 613 (61%) of the participants generally agreed that they wanted to do what their family believe they should do, while 135 (13.5%) of the participants generally disagreed that they wanted to do what their family believes they should do, and 255 (25.4%) were neutral (Table 6.6)

## Table 6.6 Mean and frequency of distributions of normative belief and motivation to comply

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Strongly Disagree** | | | **Neither disagree nor agree** | | | **Strongly agree** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| My doctor would believe that I should reuse sealed, returned blister-pack medication | 4.58 (1.67) | 68 (6.8%) | 45 (4.5%) | 67 (6.7%) | 368 (37.7%) | 131 (13.1%) | 155 (15.5%) | 169 (16.8%) |
| My pharmacist would believe that I should reuse sealed, returned blister-pack medication | 4.58 (1.77) | 88 (8.8%) | 58 (5.8%) | 62 (6.2%) | 293 (29.3%) | 154 (15.4%) | 170 (16.9%) | 177 (17.6%) |
| My close friends would believe that I should reuse sealed, returned blister-pack medication | 4.45 (1.79) | 96 (9.6%) | 65 (6.5%) | 68 (6.8%) | 317 (31.6%) | 141 (14.1%) | 151 (15.1%) | 165 (16.5%) |
| My family would believe that I should reuse sealed, returned blister-pack medication | 4.48 (1.90) | 105 (10.5%) | 83 (8.3%) | 81 (8.1%) | 237 (23.6%) | 134 (13.4%) | 182 (18.1%) | 181 (18%) |
| | | **Not at all** | | | **Neither not at all nor very much** | | | **Very much** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Generally speaking, how much do you want to do what your doctor believes you should do? | 5.55 (1.29) | 10 (1%) | 12 (1.2%) | 32 (3.2%) | 171 (17%) | 194 (19.3%) | 306 (30.5%) | 278 (27.7%) |
| Generally speaking, how much do you want to do what your pharmacist believes you should do? | 5.22 (1.36) | 12 (1.2%) | 23 (2.3%) | 52 (5.2%) | 229 (22.8%) | 219 (21.8%) | 265 (26.4%) | 203 (20.2%) |
| Generally speaking, how much do you want to do what your close friends believes you should do? | 4.40 (1.54) | 54 (5.4%) | 68 (6.8%) | 94 (9.4%) | 343 (34.2%) | 192 (19.1%) | 156 (15.6%) | 96 (9.6%) |
| Generally speaking, how much do you want to do what your family believes you should do? | 4.94 (1.48) | 28 (2.8%) | 36 (3.6%) | 71 (7.1%) | 255 (25.4%) | 224 (22.3%) | 218 (21.7%) | 171 (17%) |

#### 6.4.1.2.4 *Perceived Behavioural Control (direct and indirect) measures*

The *direct* measure of PBC was obtained using two items listed here with mean and standard deviation (SD) values, namely:

- I am confident that I could reuse medication in the future if I wanted to (disagree or agree). Mean 4.89, SD 1.78.
- For me it is (possible or impossible) to reuse medication in the future. Mean 4.86, SD 1.86.

Six hundred and twenty eight (62.5%), of the participants agreed that they are confident that they could reuse medicines in the future if they wanted to, while 195 (19.5%), disagreed that they are confident that they could reuse medicines in the future if they wanted to, and 180 (17.9%) were neutral. Moreover, 594 (59.2%) of the participants indicated that for them it is possible to reuse medicine in the future, while 221 (22.1%) indicated that for them it is impossible to reuse medicine in the future, and 188 (18.7%) were neutral (Table 6.7).

## Table 6.7 Mean and frequency of distributions of PBC

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Strongly Disagree** | | | **Neither disagree nor agree** | | | **Strongly agree** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I am confident that I could reuse medication in the future if I wanted to | 4.89 (1.78) | 69 (6.9%) | 58 (5.8%) | 68 (6.8%) | 180 (17.9%) | 196 (19.5%) | 209 (20.8%) | 223 (22.2%) |
| | | **Possible** | | | **Neither possible nor Impossible** | | | **Impossible** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| For me it is [.....] to reuse medication in the future | 4.86 (1.86) | 73 (7.3%) | 63 (6.3%) | 85 (8.5%) | 188 (18.7%) | 153 (15.3%) | 182 (18.1%) | 259 (25.8%) |

The *indirect* measure of PBC (i.e. control factor and power of the control factor) was measured using eight items. The control factors items are listed here with mean and SD value, namely:

- I expect that any medicines offered to me for reuse will be in the original, sealed, blister packaging (definitely no or definitely yes). Mean 6.19, SD 1.29.
- I expect to see evidence that any medicines offered to me for reuse would have been quality-checked (definitely no or definitely yes). Mean 6.48, SD 1.03.
- I expect to see evidence that any medicines offered to me for reuse would have been safety-checked (definitely no or definitely yes). Mean 6.55, SD 0.97.
- I expect that any medicines offered to me for reuse will have more than six months of shelf-life remaining (definitely no or definitely yes). Mean 6.10, SD 1.29.

Eight hundred and seventy two (87%) agreed that they expect any medicines that will be offered to them for reuse will be in the original, sealed, blister packaging, while 35 (3.5%) disagreed that they expect any medicines that will be offered to them for reuse will be in the original, sealed, blister packaging, and 96 (9.6%) were neutral. In addition, 920 (91.8%) of the participants agreed that they expect any medicines that will be offered to them for reuse would have been quality checked, while 18 (1.8%) disagreed that they expect any medicines that will be offered to them for reuse would have been quality checked, and 65 (6.5%) were neutral. Nine hundred and twenty eight (92.6%) of the participants agreed that they expect any medicines that will be offered to them for reuse would have been safety checked, while 14 (1.4%), disagreed that they expect any medicines that will be offered to them for reuse would have been safety checked, and 61 (6.1%) were neutral. Finally, 854

(85.2%) of the participants agreed that they expect any medicines that will be offered to them for reuse will have more than six months of shelf-life remaining, while 34 (3.4%) disagreed that they expect any medicines that will be offered to them for reuse will have more than six months of shelf-life remaining, and 115 (11.5%) were neutral (table 5.8).

The power of control factors items are listed here with mean and SD value, namely:

- It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister packaging (disagree or agree). Mean 6.13, SD 1.32.
- It would make it easier for me to reuse medication if I could see that it had been quality-checked (disagree or agree). Mean 6.37, SD 1.10.
- It would make it easier for me to reuse medication if I could see that it had been safety-checked (disagree or agree). Mean 6.40, SD 1.11.
- It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining (disagree or agree). Mean 6.01, SD 1.35.

Eight hundred and forty seven (84.5%) of the participants agreed that it would make it easier for them to reuse medicines in the future if they could see that it was in the original, sealed, blister packaging, while 40 (4%) disagreed that it would make it easier for them to reuse medicines in the future if they could see that it was in the original, sealed, blister packaging, and 116 (11.6%) were neutral. In addition, 909 (90.7%) of the participants agreed that it would make it easier for them to reuse medicines in the future if they could see that it had been quality-checked, while 24 (2.4%) disagreed that it would make it easier for them to reuse medicines in the future if they could see that it had been quality-checked, and 70 (7%) were neutral. Nine hundred and fifteen (91.3%) of the participants agreed that

it would make it easier for them to reuse medicines in the future if they could see that it had been safety-checked, while 22 (2.2%) disagreed that it would make it easier for them to reuse medicines in the future if they could see that it had been safety-checked, and 66 (6.6%) were neutral. Finally, 839 (83.6%) of the participants that it would make it easier for them to reuse medicines in the future if they could see that it had more than six months of shelf-life remaining, while 46 (4.6%) disagreed that it would make it easier for them to reuse medicines in the future if they could see that it had more than six months of shelf-life remaining, and 118 (11.8%) were neutral (Table 6.8).

## Table 6.8 Mean and frequency of distributions of control belief and power of control factor

| Items | Mean (SD) | Frequency Distribution of Responses (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Definitely no** | | | **Neither definitely no nor definitely yes** | | | **Definitely yes** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I expect that any medication offered to me for reuse will be in the original, sealed, blister packaging | 6.19 (1.29) | 14 (1.4%) | 11 (1.1%) | 10 (1%) | 96 (9.6%) | 92 (9.2%) | 165 (16.5%) | 615 (61.3%) |
| I expect to see evidence that any medication offered to me for reuse would have been quality-checked | 6.48 (1.03) | 3 (0.3%) | 6 (0.6%) | 9 (0.9%) | 65 (6.5%) | 57 (5.7%) | 131 (13.1%) | 732 (73.1%) |
| I expect to see evidence that any medication offered to me for reuse would have been safety-checked | 6.55 (0.97) | 1 (0.1%) | 4 (0.4%) | 9 (0.9%) | 61 (6.1%) | 52 (5.2%) | 104 (10.4%) | 772 (77%) |
| I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining | 6.10 (1.29) | 9 (0.9%) | 11 (1.1%) | 14 (1.4%) | 115 (11.5%) | 120 (12%) | 151 (15.1%) | 583 (58.1%) |
| | | **Strongly disagree** | | | **Neither disagree nor agree** | | | **Strongly agree** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister packaging | 6.13 (1.32) | 11 (1.1%) | 14 (1.4%) | 15 (1.5%) | 116 (11.6%) | 78 (7.8%) | 166 (16.6%) | 603 (60.1%) |
| It would make it easier for me to reuse medication if I could see that it had been quality-checked | 6.37 (1.10) | 5 (0.5%) | 3 (0.3%) | 16 (1.6%) | 70 (7%) | 78 (7.8%) | 150 (15%) | 681 (67.9%) |
| It would make it easier for me to reuse medication if I could see that it had been safety-checked | 6.40 (1.11) | 9 (0.9%) | 5 (0.5%) | 8 (0.8%) | 66 (6.6%) | 72 (7.2%) | 150 (15%) | 693 (69.1%) |
| It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining | 6.01 (1.35) | 14 (1.4%) | 9 (0.9%) | 23 (2.3%) | 118 (11.8%) | 113 (11.3%) | 189 (18.8%) | 537 (53.5%) |

In order to determine the relative importance of beliefs or to select beliefs to be targeted in behavioural interventions (i.e. in a relation to medicines reuse), multiple regression procedures and SEM were used to identify beliefs that are most important to medicines reuse as a behaviour.

Multiple regressions procedures were used to analyse the direct and indirect measures of TPB as follows. Regarding the analysis of direct measures, intention to reuse medicines in the future was the dependent (outcome) variable, with attitude, subjective norm, and PBC as the independent (predictor) variables.

Moreover, the analysis of the indirect measures was by entering the directly measured attitude scores as the dependent variable with the sum of the weighted behavioural beliefs (i.e. the sum of multiplying behavioural beliefs with outcome evaluation) as the predictor variable, the directly measured subjective norms scores as a dependent variable with the sum of the weighted normative beliefs (i.e. the sum of multiplying normative beliefs with motivation to comply) as the predictor variable, and finally by entering directly measured PBC scores as a dependent variable with the sum of the weighted control beliefs (i.e. the sum of multiplying control beliefs with the power of control factor) as the predictor variable. The preliminary regression analysis and multiple regression procedures are described in the next two sections.

### 6.4.2 Preliminary regression analysis

Several assumptions were checked before performing multiple regression analysis. While the assumptions of a linear model are never perfectly met, it was important to check if these assumptions were reasonable to work with before performing linear multiple

regression (Berry, 1993). Results from the preliminary analysis were important in allowing the researcher to generalise the findings from the sample to the entire population in the UK. The summary of the assumption results is that:

a) The relationship between the independent variables and dependent variables was linear.
b) There was no multicollinearity in the data.
c) The values of residuals were independent and uncorrelated.
d) The values of the residuals were normally distributed.
e) There were no influential cases biasing the model.

These results showed that linear multiple regression can be performed without an inclusion of outliers or influential cases and non-normal distributed nonlinear data, which could potentially bias the regression models and hence affect the findings. A full description of the assumption tests is below

#### *6.4.2.1 Multicollinearity*

First, all predictor (independent) variables except the control belief (indirect measures) showed a good relationship with the dependent (outcome) variable (i.e. with intention) as the correlation coefficients all were above 0.3, the preferable required value. The control belief variable showed a poor (<0.3) correlation value of 0.192 with the outcome variable (intention). Second, the correlation between each of the predictor variables (of both direct and indirect measures) were not too high (preferably less than 0.7) except between subjective norm and attitude where the value was 0.74 (Appendix 14).

In order to confirm that multicollinearity (that could be resulted from the poor correlation value of control belief with intention, and the high correlation between subjective norm and attitude) is not a problem, the multicollinearity diagnostic test was performed (Appendix 15). The result from the multicollinearity diagnostic test confirmed that multicollinearity is not a problem. This was because the *tolerance values* were all >0.10 indicating that the multiple correlation with other variables was not high and suggesting that the multicollinearity was not possible. In addition the *Variance Inflation Factor (VIF)* values were all <10 indicating that there is no multicollinearity. The tolerance and VIF values confirmed that multicollinearity was not violated.

#### *6.4.2.2 Normality, linearity, and outliers*

The normal probability plot (P-P) of the regression standardised residual and the scatterplot were used to check the normality and linearity (Appendix 16 and 17, respectively). In the normal probability plot (P-P) of the regression standardised residual, the points (line) lay in a reasonably diagonal line from bottom left to top right suggesting no major deviation from normality (Berry, 1993). In the scatter plot of the regression standardised residual, the residuals were roughly rectangular distributed, with most of the scores concentrated in the centres (i.e. along the 0 point line), and there was no clear systematic pattern to the residuals suggesting that there was no major deviation of the assumption (Berry, 1993). Results from the normal probability plot (P-P) of the regression standardised residual and the scatterplot confirmed normality and linearity.

With a large sample (such as that of this study), it is not uncommon to have a number of outlying residuals (Tabachnick and Fidell, 2007; Field, 2009). Outliers were checked by both Mahalanobis distances and Cook's distance output, but were difficult to detect from

the scatter plot. The Mahalanobis distances values were checked and 29 cases of outliers were found as potential problems with their values being above the critical value of 22.46, for 6 predictors (Tabachnick and Fidell, 2007).

However, the Cook's distance value was also checked with the maximum value being 0.071, suggesting no major problem (all cases in the sample had values <1) and indicated that no single case had significant influence on the model (Tabachnick and Fidell, 2007). Stevens (2012) advised that there is no point in deleting outliers if the criteria of Cook's distance are met, as these would not have a large effect on the regression analysis. As a result, the 29 cases with Mahalanobis distances value >22.46, were included in the analysis.

#### *6.4.2.3 Model evaluation*

The model explained 73.8% of the total variance (R square = 0.738) in medicines reuse. Moreover, the model summary table (Appendix 18) reported other values such as adjusted R square and the Durbin–Watson value. The R-squared value in the small sample tends to be a rather optimistic overestimation of the true value in the population (Tabachnick and Fidell, 2007). The adjusted R-Squared corrects the R square value to provide a better estimate of the true population value and generally reported with small sample size. In this study, the sample size was large and the adjusted R-Squared value was 0.736 compared to R square value (0.738), which showed no significant adjustment as the sample size was large. Finally, the Durbin–Watson value tests if there is a correlation among the residuals. The Durbin–Watson value ranged from 0 to 4, with residuals being uncorrelated if the Durbin–Watson value is approximate to 2, strong positive correlation if the value is close to zero, and strong negative correlation if the value is close to 4. In this study, the Durbin–

Watson value was 1.951, indicating that the residual were uncorrelated. The model summary results are shown in the ANOVA (Analysis of Variance) table (Appendix 18). The results were significant as the ($P < 0.001$).

### 6.4.3 Main regression analysis

#### *6.4.3.1 Analysis of direct measures*

Multiple linear regression procedures were performed by entering intention as the dependent (outcome) variable, and the direct measures of attitude, subjective norm and perceived behavioural control (PBC) as the predictor (independent) variables. The multiple linear regression was calculated to predict people's intentions to reuse medicine in the future based on their attitude, social pressure (subjective norm), and PBC to reuse medicines. A significant regression equation was found $F (3, 999) = 920.645$, $P < 0.001$, with an R square of 0.734 (i.e. three independent variables accounted for 73.4% of the variance in intention to reuse medicines in the future). Attitude, subjective norm (social pressure), and PBC toward reusing medicines were positive and (statistically) significant predictors of intention to reuse medicines ($B = 0.212$, $p < 0.001$), ($B = 0.497$, $p < 0.001$), and ($B = 0.326$, $p < 0.001$), respectively as shown in table 5.1.

#### *6.4.3.2 Analysis of indirect measures*

To confirm the validity of indirect measures of TPB, simple bivariate correlation between the direct and indirect measures of the same construct of TPB was performed (Francis et al., 2004). Validating the belief-based measures (indirect constructs) was an important step in the analysis, as it illustrated to what degree the designed indirect constructs were able to explain the direct constructs.

Bivariate correlation between behavioural beliefs and attitude construct, normative belief and subjective norm construct, and control belief and PBC construct was performed using Pearson correlation (Appendix 19). The correlation between behavioural belief and attitude (0.591), and normative belief and subjective norm (0.582) were good and significant ($P < 0.01$), while the correlation between control belief and PBC was poor (0.219) and significant ($P < 0.01$). The possible explanation for the poor correlation between control belief and PBC is that during piloting process (chapter 4), the factor loading of the items that measures the controllability of the medicines reuse behaviour was very low in two consecutives CFA analysis and hence some of the items were deleted. Therefore, the remaining items that measured self-efficacy of the medicines reuse behaviour may not have covered the breadth of the control belief construct. However, reusing medicine will be in the future as it is not allowed now to redistribute the returned unused medicine to people. This may affect people's decisions and controllability over medicines reuse behaviour which was shown in the low factor loading in the piloting phase.

Simple linear regression procedures were performed by entering directly-measured attitude scores as the dependent variable, and the sum of the weighted behavioural beliefs (the composite score of behavioural belief and outcome evaluation) as the predictor variables. A similar approach was used to predict directly measured subjective norms and perceived behavioural control (Francis et al., 2004). The simple linear regression was calculated to predict people's attitude to reuse medicines in the future based on their behavioural beliefs, subjective norms based on their normative beliefs, and PBC based on their control beliefs (Table 6.9). A significant regression equation was found between behavioural belief and attitude $F (1, 1001) = 537.756$, $P < 0.001$, with an R square of 0.349 (i.e. behaviour beliefs

accounted for 34.9% of the variance in attitude toward reusing medicines in the future), normative belief and subjective norm F (1, 1001) = 512.301, P < 0.001, with an R square of 0.339 (i.e. normative beliefs accounted for 33.9% of the variance in subjective norm toward reusing medicines in the future), and control belief and PBC F (1, 1001) = 50.507, P < 0.001, with an R square of 0.048 (i.e. control beliefs accounted for only 4.8% of the variance in PBC toward reusing medicines in the future).

Behavioural beliefs, normative beliefs, and control beliefs were positive and statistically significant predictors of attitude, subjective norm, and PBC (B = 0.024, p < 0.001), (B = 0.027, p < 0.001), and (B = 0.013, p < 0.001), respectively as shown in Table 6.9.

**Table 6.9 Results of multiple regression analysis of TPB constructs using both direct and indirect measures**

| PREDICTOR VARIABLE | B | SE | Beta (β) | t | p |
|---|---|---|---|---|---|
| **Direct Measures** | | | | | < 0.001 |
| Attitude | 0.212 | 0.025 | 0.217 | 8.545 | <0.001 |
| Subjective norm | 0.497 | 0.029 | 0.445 | 16.900 | <0.001 |
| PBC | 0.326 | 0.025 | 0.296 | 12.941 | <0.001 |
| N = 1003 participants, F = 920.645, df = 3 p < 0.001, R = 0.857, R2 = 0.734, Adjusted R2 = 0.734 | | | | | |
| **Indirect Measures** | | | | | |
| Behaviour……Attitude<br>F = 512.301, df = 1 p < 0.001, R = 0.582, R2 = 0.339, Adjusted R2 = = 0.339 | 0.024 | 0.001 | 0.591 | 2.18 | <0.001 |
| Normative belief……Subjective norm<br>F = 512.301, df = 1 p < 0.001, R = 0.591, R2 = 0.349, Adjusted R2 = = 0.349 | 0.027 | 0.001 | 0.582 | 22.634 | <0.001 |
| Control belief……PBC<br>F = 50.507, df = 1 p < 0.001, R = 0.219, R2 = 0.048, Adjusted R2 = = 0.047 | 0.013 | 0.002 | 0.219 | 7.107 | <0.001 |

Next in this chapter was the hypothesis testing and model fit assessment. The SEM with the standardised path coefficient was used to test the hypotheses and to assess the model fit. The SEM allowed for variables to correlate (while multiple regression adjusts for variables in the model) and accounted for measurement error (while multiple regression assumes perfect measurement). Hypothesis testing and model fit are described in the next two sections.

### 6.4.4 Hypothesis testing

Structural Equation Modelling (SEM) with the standardised path coefficient was applied using AMOS SPSS to test several hypotheses in this study (Figure 6.4).

a) ***Hypothesis 1:*** **There will be a positive relationship between attitude toward reusing medicines and intention to reuse medicine in the future?**

Hypothesis 1 was supported by the data. The attitude toward reusing medicines had the lowest standardized path coefficient of 0.27 ($p < 0.001$, $n = 1{,}003$). This showed a low to moderate and statistically significant relationship suggesting that the attitude toward reusing medicines had a positive effect on the intention to reuse medicines in the future. Therefore, people's attitude (i.e. if reusing medicines in the future would be beneficial, worthwhile, satisfying, and good) had some, but in fact the lowest, influence in on their intentions to reuse medicines in the future.

***b)*** ***Hypothesis 2:*** **There will be a positive relationship between subjective norm toward reusing medicines and intention to reuse medicine in the future?**

Hypothesis 2 was strongly supported by the data. The subjective norm toward reusing medicines had the highest standardized path coefficient of 0.55 ($p < 0.001$, $n = 1{,}003$). This showed a moderate to high and statistically significant relationship suggesting that the subjective norm toward reusing medicines had the strongest positive effect on the intention to reuse medicines in the future, among the three direct-measure constructs of TPB. Therefore, the social pressure (for example, most people who are important to me would want me to reuse medicines in the future, or approve if I decided to reuse medicine in the

future, or think that I should reuse medicine in the future) had significant influence on people's intentions to reuse medicines in the future.

c) ***Hypothesis 3:*** **There will be a positive relationship between PBC toward reusing medicines and intention to reuse medicine in the future?**

Hypothesis 3 was supported by the data. The PBC toward reusing medicines had the standardized path coefficients of 0.37 ($p < 0.001$, $n = 1003$), this showed a moderate and statistically significant relationship suggesting that the PBC toward reusing medicines had moderate positive effect on the intention to reuse medicines in the future among the three direct-measure constructs of TPB. Therefore, people's self-efficacy (for example, if people are confident to reuse medicine in the future or reusing medicine in the future is possible for them) has moderate influence on their intentions to reuse medicines in the future.

d) ***Hypothesis 4:*** **There will be a positive relationship between behavioural beliefs and attitude toward reusing medicines in the future?**

Although a person may hold many behavioural beliefs in relation to any behaviour, only a relatively small number are readily accessible at a given moment (Ajzen, 2002). This hypothesis assumed that people's beliefs, in combination with the subjective values of the expected outcomes, had an effect to determine attitude. The hypothesis was supported by the data. In fact, it was the highest standardized path coefficient in the analysis with a path coefficient of 0.59 ($p < 0.001$, $n = 1,003$). This suggests that there is moderate to strong relationship in which behavioural beliefs (for example, if people think that by reusing medicine they will contribute in reducing the harmful effect of medicines on the environment and the amount of money spent by the NHS on medicines) predict attitude

toward (for example, medicines reuse is beneficial, worthwhile, good, and satisfying for them) reusing medicines in the future. The more positive people's beliefs, the more they are likely to indicate a positive attitude toward reusing medicines in the future.

**e) *Hypothesis 5:* There will be a positive relationship between normative beliefs and subjective norms toward reusing medicines in the future?**

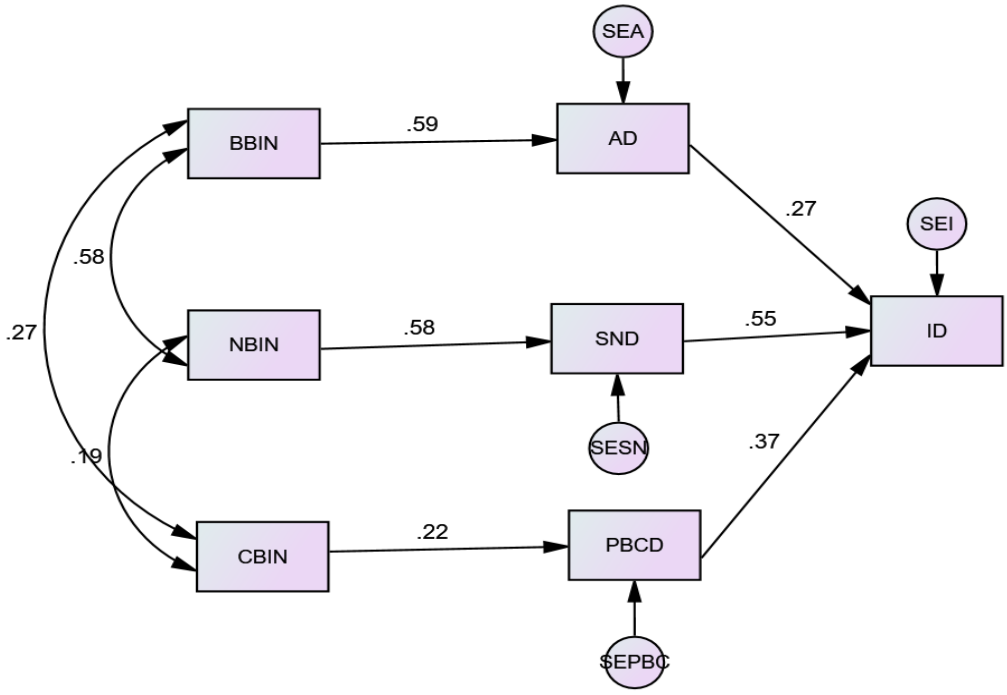
The hypothesis was supported by the data. The standardized path coefficient was the second highest in the analysis with a path coefficient of 0.58 ($p < 0.001$, $n = 1{,}003$). This suggests that there is a moderate to strong relationship in which normative beliefs predict subjective norms toward reusing medicines in the future. The more positive people's normative beliefs (for example, people think that their doctor, pharmacist, family, and close friends would want them to reuse medicines in the future), the more they are likely to indicate a positive subjective norm toward reusing medicines in the future (for example, most people who ae important to me would want me to reuse medicines in the future, or approve if I decided to reuse medicine in the future, or think that I should reuse medicine in the future).

***f) Hypothesis 6:* There will be a positive relationship between control beliefs and PBC toward reusing medicines in the future?**

Although the hypothesis was supported by the data, the standardized path coefficient was the lowest in the analysis with a path coefficient of 0.22 ($p < 0.001$, $n = 1{,}003$). This suggested that there is a low to moderate relationship in which control beliefs predict PBC toward reusing medicines in the future. The more positive people's control beliefs (for example, people expect that medicines offered for reuse are in original sealed blister

packaging and would have been quality and safety checked), the more they are likely to indicate a positive PBC (for example, are more likely to be confident in reusing medicines in the future and medicines reuse will be possible for them) toward reusing medicines in the future.

**Figure 6.4 SEM of the TPB model with standardised path analysis results (before model fit procedures)**




BBIN (Behavioural Belief Indirect measure), NBIN (Normative Belief Indirect measure), CBIN (Control Belief Indirect measure), AD (Attitude Direct measure), SND (Subjective Norm Direct measure), PBCD (Perceived Behavioural Control Direct measure), ID (Intention Direct measure), SEA (Standard Error Attitude), SESN (Standard Error Subjective Norm), SEPBC (Standard Error Perceived Behavioural Control), and SEI (Standard Error Intention).

g) ***Hypothesis 7:*** **There is no significant difference in intention to reuse medicines in the future by gender**

An independent t-test was performed and showed no statistically significant difference in the mean intention scores between male (mean = 4.58, SD = 1.852, n = 494) and female participants (mean = 4.75, SD = 1.740, n = 509) with t value = -1.506, d.f = 1001, and (P = 0.132).

h) ***Hypothesis 8:*** **There is no significant difference in intention to reuse medicines in the future by age**

A one-way ANOVA was performed and showed no statistically significant difference in mean intention score between the different age groups (F = 0.971, d.f = 13, 1002, p = 0.478).

i) ***Hypothesis 9:*** **There is no significant difference in intention to reuse medicines in the future by ethnicity**

A one-way ANOVA was performed and showed no statistically significant differences in mean intention score between different ethnicity groups (F = 0.954, d.f = 17, 1002, p = 0.509).

j) ***Hypothesis 10:*** **There is no significant difference in intention to reuse medicines in the future by level of education.**

A one-way ANOVA was performed and showed no statistically significant differences in mean intention score between educational levels (F = 1.665, d.f = 16, 1002, p = 0.480).

k) ***Hypothesis 11:*** **There is no significant difference in intention to reuse medicines in the future by geographical distribution**

A one-way ANOVA was performed and showed no statistically significant difference in mean intention score between different geographical areas ($F = 0.989$, $d.f = 12, 1002$, $p = 0.457$).

### 6.4.5 Model fit analysis

Having analysed the standard inter-relationship between the different constructs of the TPB, an additional set of tests was completed in order to check the model fit. This is completed to check whether the standard relationship between the different constructs of the TPB proposed by the original model apply in relation to the data obtained in this study. This means, for example, that although the TPB predicts a relationship between the indirect and direct measures of attitude toward medicines reuse, it might be that in fact indirect measures of attitude also strongly predict another direct measure. Checking the model fit will highlight whether there is a need to explore other new relationships between the constructs of this particular questionnaire that would better predict people's intention to reuse medication.

Several common model-fit measures were checked to assess the model's overall goodness-of-fit using AMOS (SPSS). These tests included Chi-square, Root Mean Square Error of Approximation (RMSEA), Normalized Fit Index (NFI), Tucker Lewis Index (TLI) and the Comparative Fit Index (CFI). These are standard modification indices offered by AMOS SPSS. Overall, the path analysis of SEM reported non-satisfactory results in terms of model-fit and significance of relationships. This means that the diagnostic analysis of

model-fit, as listed above, showed poor fit of the TPB model to the data. The details of this model fit is described in the next sections and summarized in Table 6.10.

#### *6.4.5.1 RMSEA*

The Root Mean Square Error of Approximation (RMSEA) is a common way to measure model-fit. The RMSEA was applied and failed to show a satisfactory score. The RMSEA for the default model was 0.327 (all relationships in this model reported significant p-values (p = 0.000)). According to Kenny (2011), the recommend RMSEA for good models is 0.05 or less, and models in which RMSEA is 0.10 or more have a poor fit. The RMSEA value of 0.327 reported in this study indicated poor model fit.

#### *6.4.5.2 Chi-Square*

Chi square ($\chi 2$) is the original fit index and is considered the basis for most other fit indices. However, there are many factors that affect the $\chi 2$ such as sample size, the number of the variables in the model, and the distribution of the variables (Bentler, 1990). The $\chi 2$ value was 1298.857, (degrees of freedom (D.F) = 12; $p < 0.001$). The $\chi 2$ value was very large and statistically significant which indicated a poor model fit.

In this study, the distribution of the variables was checked to be normally distributed and had no effect to increase the value of $\chi 2$. However, the reason of having large and statistically significant $\chi 2$ value is possibly the number of variables in this model (as the number of variables increase the $\chi 2$ value will increase), and more importantly the large sample size. Although the $\chi 2$ value did not meet its recommended value which indicated poor fit, the significant p-value might be explained by the large sample size in this study. As a result, $\chi 2$ value was considered not to be a useful fit index parameters to report as it is very sensitive to sample size.

#### *6.4.5.3 Other fit indices*

The default model-fit reported scores with 0.676 for NFI, 0.435 for TLI, and 0.677 for CFI. These value indicated poor model fit. A score of 0.90 or above on these indices indicates a good fit as recommended by Kenny (2011). While the CFI and NFI values was close to 0.9, TLI was away from the recommended value. These fit indices also indicated poor model fit.

**Table 6.10 Measures of model fit value which indicate poor model fit**

| Test | Recommended value | Model value | Degree of model fit |
|---|---|---|---|
| Chi-square<br>Chi-square/d.f | P ≥ 0.05<br>≤ 5 | 1298.857*<br>108.238 | Poor fit |
| RMSEA | ≤ 0.08 | 0.327 | Poor fit |
| NFI | ≥ 0.9 | 0.676 | Poor fit |
| TLI | ≥ 0.9 | 0.435 | Poor fit |
| CFI | ≥ 0.9 | 0.677 | Poor fit |
| d.f = degree of freedom; * P ≤ 0.001 | | | |

### 6.4.6 Modification indices

Having found that the standard TPB model fit was poor, further analyses were completed in order to examine and explore the additional relationships between the different constructs of the MRQ and to report the statistically significant relationships which potentially override the standard relationships proposed by the original TPB. This was important to complete because if the model does not have a good fit, its predictive power (i.e. to predict intention to reuse medicines) will be low despite the path analysis reported in Figure 6.4. Thus for example, although there is a strong correlation between the indirect and direct measures of subjective norm (which in Figure 6.4 was reported to be the strongest predictor of intention to reuse medicine), i.e. correlation of 0.58, if the model fit is poor, in

fact there might be other stronger relationships between the different constructs that would override this apparent relationship. Therefore in order to explore a better model for predicting intention to reuse medication (i.e. a model whose fit would be good), the Modification Indices (MI) were calculated. This is a standard mechanism within AMOS SPSS.

Using AMOS to assess the model, the Modification Indices (MI) - a lower bound estimate of the expected chi square decrease that would result when a particular parameter is left unconstrained or there is the addition of an extra path was used improve TPB model fit. The modification indices were checked to be at least 5 before the model was considered to be modified as recommended by Jöreskog and Sörbom (2005).

Using AMOS SPSS, MI suggested 11 new relationships between the construct of TPB model as presented in (Table 6.11). These relationships were checked carefully and only logical relationships between constructs (i.e. the new relationships between the constructs should make sense in a relation to medicine reuse as the behaviour) were used to improve the model fit.

**Table 6.11 All the new relationships between the model constructs suggested by MI to improve the model fit**

| All the new relationships between the constructs | | | MI |
|---|---|---|---|
| Normative belief | → | Perceived Behavioural Control | 191.137 |
| Behavioural belief | → | Perceived Behavioural Control | 241.787 |
| Subjective norm | → | Perceived Behavioural Control | 430.755 |
| Attitude | → | Perceived Behavioural Control | 372.591 |
| Behavioural belief | → | Subjective norm | 53.964 |
| Perceived Behavioural Control | → | Subjective norm | 238.809 |
| AD (Attitude Direct measure) | → | Subjective norm | 312.129 |
| Normative belief | → | Attitude | 37.007 |
| Perceived Behavioural Control | → | Attitude | 156.050 |
| Subjective norm | → | Attitude | 288.170 |
| Normative belief | → | Intention | 7.701 |

In this study, the MI was not allowed to drive the process of improving fit without checking if the new relationships proposed in the model make sense and logic in a relation to medicine reuse as behaviour, this was in line with the SEM guidelines for determining model fit which was recommended by Hooper et al. (2008). The logical new relationships used for improving model fit were described below and are presented in (Table 6.12).

First, the AMOS model analysis indicated that the chi-square would drop dramatically (M.I. = 288.170) if a path is drawn from subjective norms to attitude (Figure 6.5). After the path was drawn from subjective norms to attitude, a significant improvement in modification indices occurred as ($\chi 2$) value improved (from 1298.857 into 791.621), RMSEA (from 0.327 into 0.266), NFI (from 0.676 into 0.803), TLI (from 0.435 into 0.626), and CFI (from 0.677 into 0.804). This would make sense theoretically as people's own attitudes generally could be affected by what they believe to be the perceptions of key referents in their lives. For example, individuals would believe that people who are important to them would approve of them reusing medicines in the future and this could positively impact on the individual's attitude toward reusing medicines in the future. While this cross effect between subjective norms and attitude was not part of Ajzen's TPB, it was reported by Powpaka (2002), who noted a direct relationship between attitude and subjective norms when using TPB to study management decision-making. Moreover, Bansal and Taylor (2002), also identified an interaction between subjective norms and attitude toward the behaviour when using TPB to study service providers switching context. Finally, Koo and Kwong (2006) reported the same crossover effect in which subjective norms influenced attitude formation in a study using TPB to examine the adoption of podcasting in enhancing learning.

Second, the AMOS Model also indicated the chi-square would drop significantly (M.I. = 430.755) if a path is drawn from subjective norms to PBC (Figure 6.5). After the path was drawn from subjective norms to attitude, a further significant improvement in modification indices occurred as ($\chi 2$) value improved (from 791.621 into 214.535), RMSEA (from 0.266 into 0.143), NFI (from 0.803 into 0.946), TLI (from 0.626 into 0.892), and CFI (from 0.804 into 0.949). This could be explained as the people's own confidence or decision to reuse medicines in the future could be affected by what they believe to be the perceptions of key referents in their lives.

Third, the AMOS Model also indicated the chi-square would drop (M.I. = 48.405) if a path is drawn from behavioural beliefs to PBC (Figure 6.5). After the path was drawn from subjective norms to attitude, a further improvement in modification indices occurred as ($\chi 2$) value improved from (214.535 into 141.030), RMSEA (from 0.143 into 0.121), NFI (from 0.946 into 0.965), TLI (from 0.892 into 0.923), and CFI (from 0.949 into 0.967). This make sense as person individual beliefs for a behaviour, for example (I think for me to reuse medicine in the future would reduce the harmful effect of medicines in the environment) may affect their confidence or decision to perform the behaviour (i.e. I am confident to reuse medicines in the future).

Fourth, the AMOS Model also indicated the chi-square would drop (M.I. = 20.627) if a path is drawn from PBC into attitude (Figure 6.5). After the path was drawn from PBC into attitude, a further improvement in modification indices occurred as ($\chi 2$) value improved (from 141.030 into 101.341), RMSEA (from 0.121 into 0.108), NFI (from 0.965 into 0.975), TLI (from 0.923 into 0.939), and CFI (from 0.967 into 0.977). The possible explanation is that a person's confidence or decision to reuse medicine could have an

influence in the person's attitude to reuse medicine in the future (i.e. if participants were confident in their decision to reuse medicine, they will value if medicine reuse is worthwhile or not).

Finally, the AMOS Model also indicated the chi-square would drop (M.I. = 53.964) if a path is drawn from behavioural belief into subjective norm (Figure 6.5). After the path was drawn from behavioural belief into subjective norm, a further improvement in modification indices occurred as ($\chi 2$) value improved (from 101.341 into 16.755), RMSEA (from 0.108 into 0.037), NFI (from 0.975 into 0.996), TLI (from 0.939 into 0.993), and CFI (from 0.977 into 0.998). This makes intuitive sense as a person's positive belief for a behaviour, for example (I think for me to reuse medicine in the future would reduce the harmful effect of medicines in the environment) would influence what they believe other people they consider important to them such as family or close friends, would think about the reuse of medicine. This was shown in the qualitative interview (i.e. elicitation study), where some participants said that they were discussing the value of medicine reuse (i.e. their behavioural beliefs about medicine reuse) with their partners (i.e. their subjective norm) therefore it is possible that projecting their own beliefs onto those of others close to them.

**Table 6.12 The only relationships used to improve the model fit**

| Only the relationships between the constructs that were used to improve the model fit | | |
|---|---|---|
| Subjective norm | → | Attitude |
| Subjective norm | → | Perceived Behavioural Control |
| Behavioural belief | → | Perceived Behavioural Control |
| Perceived Behavioural Control | → | Attitude |
| Behavioural belief | → | Subjective norm |

After modification indices were corrected, model had a very good fit. The new path analysis are shown in (Figure 6.5). Although the subjective norm standardized path coefficient value reduced from 0.55 to 0.45 ($p < 0.001$, $n = 1003$) as a results of new relationships between the construct, the subjective norm is still the strongest predictor of intention to reuse medicines compared to attitude and PBC. The measured value of model fit achieved after MI were applied to improve the model fit are shown in (

Table 6.13 ).

**Figure 6.5 TPB model after modification indices was corrected showing the new relationships between the constructs**

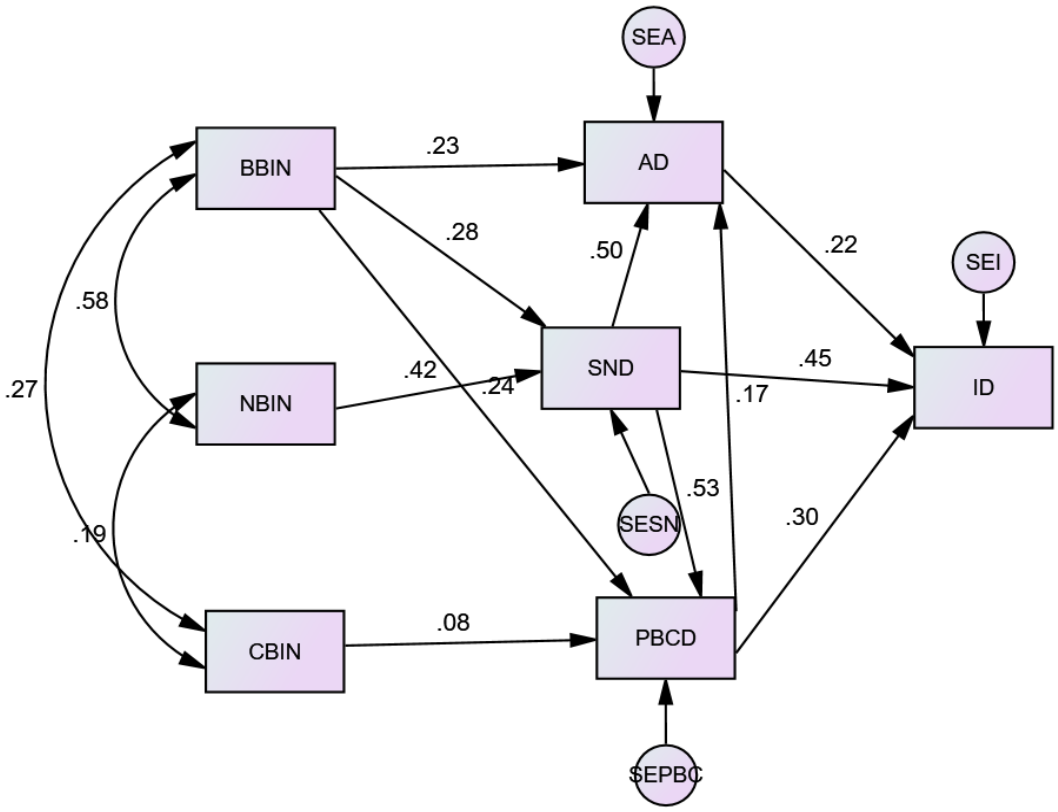


**Table 6.13 Measures of model fit achieved after MIs were applied to improve the model fit**

| Test | Recommended value | Model value | Degree of model fit |
|---|---|---|---|
| Chi-square<br>Chi-square/d.f | P ≥ 0.05<br>≤ 5 | *16.755<br>108.238 | Good fit (taking into consideration the effect of large sample) |
| RMSEA | ≤ 0.08 | 0.037 | Good fit |
| NFI | ≥ 0.9 | 0.996 | Good fit |
| TLI | ≥ 0.9 | 0.993 | Good fit |
| CFI | ≥ 0.9 | 0.998 | Good fit |
| d.f = degree of freedom; * P ≤ 0.001 | | | |

## 6.5 Discussion

This chapter described phase 3 of the larger study the results of which are briefly summarised here. In the literature, there are no previous reports about people's attitudes and intention to reuse medicines in the future. The purposes of this study was first to disseminate the MRQ to predict nationwide views about people's attitudes and intentions to reuse medicines in the future and then to evaluate the predictive utility of TPB in understanding people's attitudes and intentions to reuse medicines in the future.

This study demonstrated the key findings about medicines reuse and how TPB can be used to identify and measure factors that influence reusing medicines in the future, which can facilitate the design of medicines reuse intervention strategies. Supporting previous studies, all of the main prediction variables from (Ajzen, 2006) TPB model (subjective norm, attitude toward reusing medicines and PBC) were statistically significant at varying strengths. In contrast to previous studies, the subjective norms construct had the strongest

standardized beta of the three independent variables of direct measures. The subjective norms had the strongest positive effect on intentions with standardized path coefficient of 0.55 ($p < 0.001$, $n = 1003$). As there are no studies using TPB in relation to reusing medicines in the literature, it was difficult to assess if the strong subjective norm influence is unique to medicines reuse. The subjective norms having the strongest positive effect on intention can be considered as the strongest candidate for a medicines reuse behavioural intervention and this could help inform any future policy on reducing medicines waste through reuse in the future. The strong subjective norm influence was a surprising results as it was reported that subjective norm has the weakest effect on intention by Armitage and Conner (2001), who reviewed 185 studies involving TPB.

In addition, in this chapter, the attitude toward reusing medicines has the weakest positive effect on intentions compared to subjective norm and PBC with standardized path coefficient of 0.27 ($p < 0.001$, $n = 1003$). This is also possibly contradicting with previous research involving TPB specifically for attitude. For example, in the meta-analysis of 56 studies involved TPB (Godin and Kok, 1996), it was reported that attitude toward the behaviour and PBC were found to be the most significant predictors. In the current study, the PBC has the positive effect on intention with standardized path coefficient of 0.37 ($p < 0.001$, $n = 1003$). The PBC positive effect on intention was consistent with previous research involved TPB as reported by Godin and Kok (1996).

There were no significant relationships found between the background factors variables such as age, gender and ethnicity, level of education and demographic distribution and intention to reuse medicines in the future, possibly also contradicting several previous studies that used TPB.

The model fit for this study was poor as indicated by five different scores and tests (i.e. $\chi 2$, RMSEA, NFI, TLI and CFI). Given the complexity of SEM, it is not uncommon have a poor model fit. The normality of the data was checked and confirmed in the preliminary analysis, therefore this was excluded as a possible cause of having poor model fit. Other possible reasons related to having poor model fit in this study were (Iacobucci, 2010; Kenny, 2011);

a) In this study, the sample size was large. The Chi square ($\chi 2$) test is sensitive to sample size, the larger the sample size the larger the $\chi 2$ value, the poorer the model fit. In addition, NFI, TLI and CFI are possible affected by large sample sizes. However, these are not considered to be as sensitive to large sample sizes as Chi square is.
b) This study has constructs that have four or more items and this is probably considered excessive when using SEM and adds complexity to the model possibly affecting the model fit.
c) The constructs of past behaviour and the actual behavioural control were not included in this study as medicines reuse is not allowed in the UK, therefore it is not possible to measure the actual behaviour or past behaviour. As a result, the variables in these constructs (i.e. past behaviours and actual behavioural control) were not included in the TPB model, this possibly affecting model fit.

It is important to mention that MIs was used carefully. Only modification indices that the researcher felt is logical with medicines reuse as a behaviour were used to improve the model fit. Therefore the researcher did not allow the MIs to drive the process of improving fit without checking if the new relationships proposed in the model make sense and are

logic, this was according to the recommendation by Hooper et al. (2008). In this chapter, the MIs indicated a significant relationship between subjective norms to attitude, between subjective norms and PBC, behavioural beliefs to PBC, PBC into attitude, and behavioural belief into subjective norm. These relationships are not part of Ajzen (2006) TPB and may require further research.

The strength of this largescale study is that it captured representative views about medicines reuse, something that has never been addressed in the literature. This study provided the first detailed and robust investigation about people's beliefs, attitudes and intentions to reuse medicines in the future. Another strength is the application of TPB (i.e. applying the theory driven approaches) which helped the selection of variables used for statistical analysis and directed the interpretation of findings, at the same time enhancing the reliability and validity of the findings and conclusions made. Moreover, the design of TPB provided structured and robust information about medicines reuse behaviour that will inform any future policy on reducing medicines waste through reuse in the future. Finally, the analysis of the results involved checking the assumptions of the statistical tests during preliminary analysis, and also a test of model fit and modifying the indices. These processes have not been well explored or sometimes neglected in past studies raising questions about the validity and reliability of the TPB construct in some of these studies but clearly these areas were addressed in this thesis.

Research using panels can be limited by issues relating, for example, to whether members are representative of the target population. This was addressed by using quotas and screening questions resulting in a representative sample. However, the use of an online panel would have excluded people with no internet access. Therefore, this could be a

limitation in this study as the use of an online questionnaire which would have excluded views from people with no internet access.

In addition, another limitation is that the PBC construct (i.e. direct measure) was measured using only two items (items measuring self-efficacy of medicine reuse), as the items measuring controllability of medicines reuse were deleted as result of two consecutive CFA. Having only two items may not cover the depth of the PBC construct and result in lower internal consistency compared to attitude and subjective norm construct.

This chapter presents a novel approach of investigating nationwide opinions on medicines reuse that has not been fully addressed in the literature. It provides the first detailed research about people's beliefs, attitudes and intentions to reuse medicines in the future. The viewpoints were captured from a large and representative sample of the UK patient population, providing robust evidence about patients' beliefs and intentions to take part in medicines reuse. The results from this chapter can inform any future policy on reducing medicines waste through reuse in the future.

## 6.6 Conclusion

The results from this research suggest that people in UK have a positive intention to reuse medicines and could reuse medicine in the future. This was supported by their strong and positive beliefs and attitudes. However, assuring the safety and quality of the medicines that will be offered for reuse is a vital criteria for them to agree to reuse medicines in the future. In addition, People's behavioural (advantages and disadvantages), normative (social pressure) and control beliefs (safety and quality of unused medicines) were all statistically significant concepts to predict people's intention to reuse medicines in the future. From

these three concepts, social pressure (i.e. subjective norm) from pharmacist, GPs, family and friends were found to have the strongest effect in predicting intentions to reuse medicines in the future. These concepts especially social pressure concepts can be targeted and used to develop behavioural intervention and can help inform any future policy on reducing medicines waste through reuse in the future. This study demonstrated how TPB can be used to identify and measure factors that influence reusing medicines in the future, and this could facilitate the design of medicines reuse intervention strategies, in addition, showed the importance of PBC to predict medicine reuse as behaviour. Moreover, this study also showed new relationships between the direct and indirect measures of TPB that have not been reported by Ajzen TPB and may require further research. The new relationships between the direct and indirect measures of TPB demonstrated the flexibility of TPB and its effectiveness as a tool to predict people's beliefs and intentions to reuse medicines in the future.

# CHAPTER 7 THESIS SUMMARY, SIGNIFICANCE AND LIMITATION, IMPACT AND FUTURE, AND MEDICINAL WASTE IN JORDAN

## 7.1 Summary and key findings

This thesis examines the idea that unused prescribed medicines returned by one patient to a pharmacy can be dispensed and reused by another patient ("medicines reuse") as a strategy for reducing medicinal waste in the UK. Medicinal waste can be generated when the prescribed medicines are left unused and stored at home, returned back to the pharmacies, or disposed of into household waste, or flushed down sinks and toilets, ending up in landfill sites and the water system. Medicinal waste has a financial cost which is estimated in the UK to be £300 million per year for prescribed medicines (Trueman et al., 2010). However, monetary cost is only part of the burden of medicinal waste. Environmental costs are also a concern as the presence of pharmaceuticals in the environment increases with inappropriate disposal of medicinal waste potentially contributing. Research has found that people are more likely to dispose of their unused medicines in the common refuse or flush down the sink/toilet than return them to the pharmacies for correct disposal (Vellinga et al., 2014).

The causes of medicinal waste are thought of as avoidable (e.g. patient non-adherence, adverse drug reactions, medicine accumulation) or non-avoidable (e.g. patient death, prescription changes). To reduce medicinal waste, one approach is to prevent waste in the first place. Interventions that have tried to prevent waste have not always been effective and paradoxically, the most common causes of medicinal waste are non-preventable (West et al., 2014). Another approach is to reuse medicines. Medicines reuse is a sustainable concept yet to be tested in the UK. Medicines reuse remains largely unexplored because unused medicines are not currently allowed to be reused in the UK. Instead the returned

unused medicines are automatically considered as waste that requires appropriate disposal. Medicine reuse could potentially have a wider impact on medicinal waste by enabling medicines returned by patients (irrespective of reasons) to be considered for re-distribution to others following quality control. Medicines reuse has the potential to reduce the environmental and economic impact of medicinal waste, providing a sustainable solution for all causes of medicinal waste in the future.

Anecdotally, patients returning their medicines to the pharmacies often voice a wish for these to be reused by others. In fact, an NHS sustainability survey which was carried out by Ipsos MORI in 2011 reported that half of the respondents were likely to accept the reissued medicines returned to the pharmacies. Moreover, there is precedence of medicines reuse in other countries. For example in the United States, unused medicines are collected and redistributed to patients who are less able to afford the cost of medicine.

The implementation of medicines reuse in the UK would rely heavily on people's uptake of this idea. Therefore, this thesis set out to develop an understanding of what the public thinks about this concept. To date no other formal research study had examined the general public's views about and openness to the idea of medicines reuse, with one study only focussing on pharmacists' views (McRae et al., 2016a).

This thesis aimed to capture nationwide views about people's beliefs, attitudes, and intentions to reuse medicines in the future using a mixed method design and applying TPB. It provides the first detailed research reports about people's beliefs, attitudes and intentions to reuse medicines in the future. The viewpoints were captured from a large and representative sample of the UK patient population, providing robust evidence about

patients' beliefs and intentions to take part in medicines reuse. The results can inform any future policy on reducing medicines waste through reuse in the future.

In the elicitation study (i.e. phase one), qualitative interviews were used to define medicines reuse as a behaviour and identify behavioural, normative, and control beliefs about medicines reuse. Medicine reuse as a behaviour was defined as the idea that you would accept for your own personal use a prescription medicine that has been previously given out to another patient but then returned to a pharmacy, where the pharmacist has verified that the medicine: has been kept by the other patient for less than three months, has more than 6 months of shelf-life remaining, has not been tampered with, has been kept under normal storage conditions, and has been kept in the original sealed blister pack (i.e. medication strip). This is in relation to adult patients prescribed medicines for a long-term condition with the capacity to consent. In addition, the mapped themes obtained from inductive thematic analysis in the elicitation study were then categorised against TPB within a deductive approach in which three major categories were identified and labelled (in Chapter 4). This is summarised in the (Figure 7.1).

After an elicitation study was completed (phase 1), the MRQ was developed, piloted and evaluated using validity and reliability tests. A valid and reliable final version of the MRQ (phase 2) was ready to be disseminated nationwide to capture people's beliefs, attitudes, and intentions to reuse medicines in the future (phase 3 of the study).

The key findings from the quantitative analysis of the MRQ (i.e. phase 3) suggested that people living in the UK have positive intentions to reuse medicines and could reuse medicines in the future. The positive intentions to reuse medicines were based on people's

strong beliefs about the economic and environmental advantages that medicines reuse could provide. However, safety and quality of the medicines that will be offered for reuse are vital for people to agree to reusing medicines in the future. Most of the respondents thought reusing medicines in the future would be beneficial, worthwhile, would contribute to reducing the harmful effect of medicinal waste into the environment and reducing the NHS medicines spend. This was juxtaposed with a belief that medicines reuse was more likely to result in receipt of low quality unsafe, or incorrect medication. Nonetheless, more than half of the respondents intended or wanted to reuse medicines in the future with the expectation that medicines offered for reuse would have been subjected to safety and quality checks, would remain in original sealed blister packaging, with more than six months remaining shelf-life.

Another key finding from the quantitative analysis of the MRQ suggested that subjective norm has the strongest positive effect on people's intentions to reuse medicines in the future. This suggests that the social pressure of people who might approve someone's decision to reuse medicines in the future, such as pressure from doctors, pharmacists, family, and close friends was found to be the highest influence on the decisions of the participant's to reuse medicines in the future compared to the (low to moderate) participant's own attitude (i.e. whether reusing medicines is good, worthwhile, beneficial, and satisfying for them) and moderate influence of the participant's PBC (i.e. participant confidence to reuse medicines and if medicines reuse is possible to them) to reuse medicines in the future.

The final key finding from quantitative analysis was related to the utility of applying Ajzen (2006) TPB model, explained by the SEM procedure in which the modification indices

suggested new relationship that are not part of TPB model proposed by Ajzen (2006) TPB model. These relationships were between subjective norms to attitude, subjective norms to PBC, behavioural beliefs to PBC, PBC to attitude, and behavioural belief to subjective norm (Figure 7.2).

The key findings in this thesis suggested that although people have concerns about medicines reuse, the idea is not unpalatable provided certain caveats are put in place. In addition, these key findings can inform any future policy on reducing medicines waste through reuse in the future. Moreover, the subjective norms having the strongest positive effect on intention can be considered as the strongest construct for a medicines reuse behavioural intervention and can help inform any future policy on reducing medicines waste through reuse in the future.

The strength of this research is that it captured viewpoints from a large and representative sample of the UK patient population, providing robust evidence about patients' beliefs and intentions to take part in medicines reuse in the future. The limitations of this research are related to the use of an online questionnaire which would have excluded people with no internet access. The strengths and limitations of this thesis are further described below.

**Figure 7.1 described the major themes obtained from the elicitation study categorised against the indirect constructs of TPB**

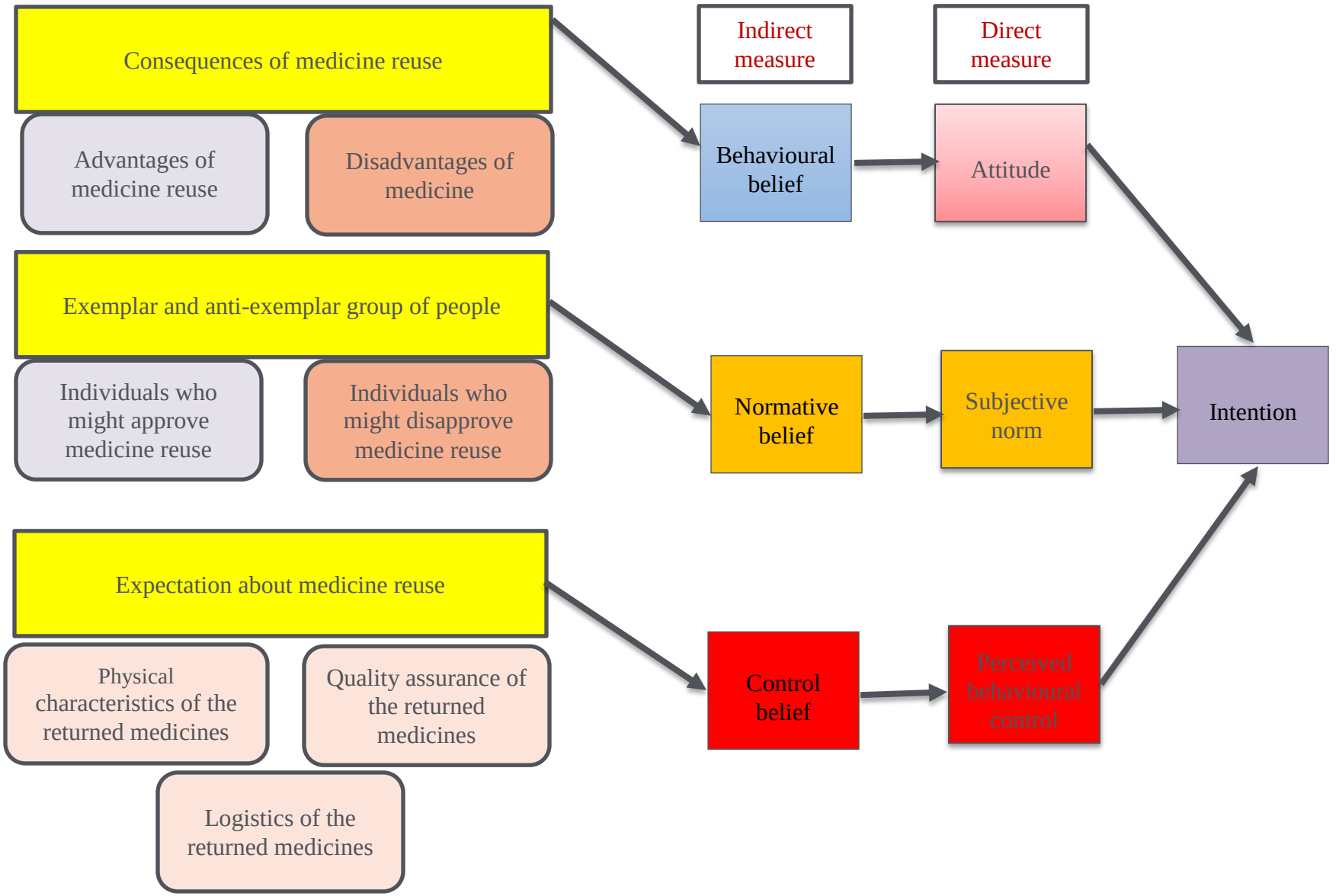
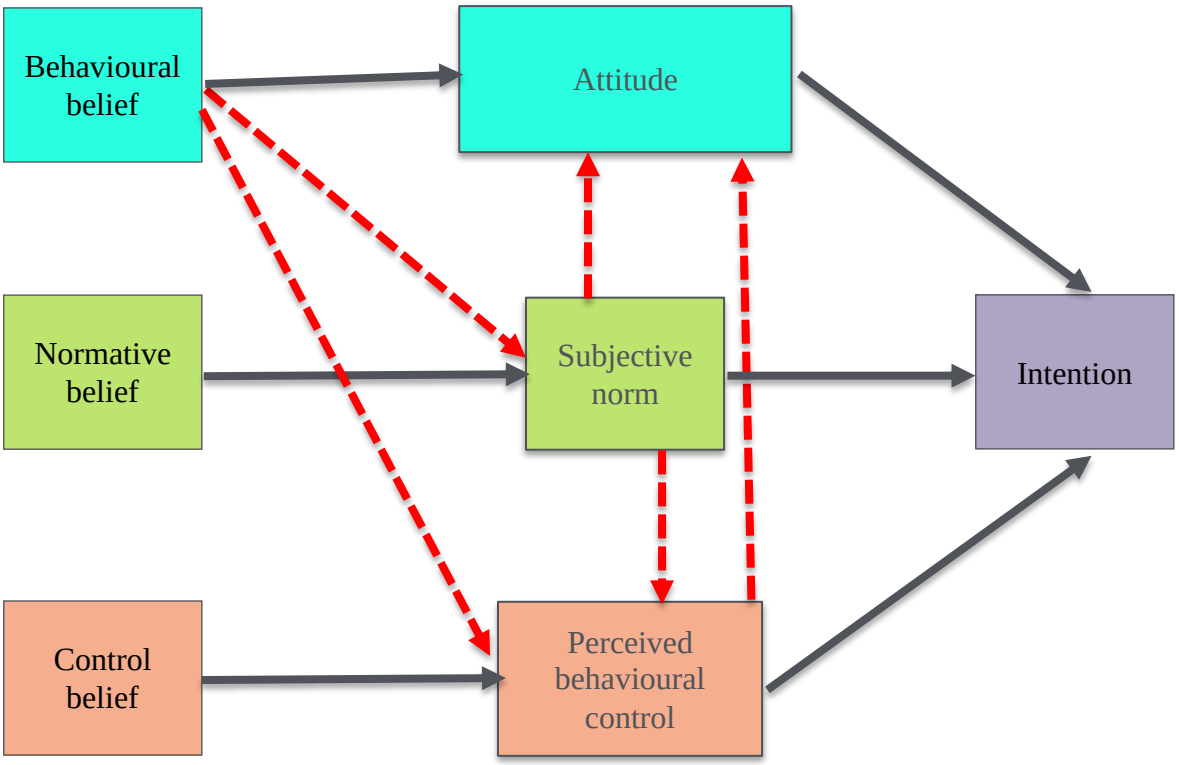


**Figure 7.2 TPB model fit with new relationships showed in red (squared dot) arrows as a result of modification indices**




## 7.2 Strength of the thesis

This thesis presents a novel approach of investigating nationwide opinions on medicines reuse that has not been fully addressed in the literature. It provides the first detailed research about people's beliefs, attitudes and intentions to reuse medicines in the future. The viewpoints were captured from a large and representative sample of the UK patient population, providing robust evidence about patients' beliefs and intentions to take part in medicines reuse. The results from this thesis can inform any future policy on reducing medicines waste through reuse in the future.

The design, development, and validation of the MRQ, which required an elicitation study, and thorough analysis are considered another strength to this study. Moreover, the

validation involved a series of reliability and validity testing to pilot the MRQ. In addition, the results were quantified via disseminating the MRQ to a cross section of 1,003 people in the UK. The analysis of the results involved checking the assumptions of the statistical tests during preliminary analysis, and also a test of model fit and modifying the indices. These processes have not been well explored or sometimes neglected in past studies raising questions about the validity and reliability of the TPB construct in some of these studies but clearly these areas were addressed in this thesis.

Another strength to this thesis is applying the theory driven approaches especially when using mixed methods design (Evans et al., 2011). The TPB worked as a navigational device throughout this thesis, helped in simplifying the study of a complex human behaviour (i.e. in terms of methods of investigation that take into account the importance of causal mechanisms). In particular, the TPB helped scaffolding and refining the design in this study during development of the MRQ constructs. Moreover, TPB helped advise the selection of variables used for statistical analysis and directed the interpretation of findings, at the same time enhancing the reliability and validity of the findings and the conclusions made. Finally, the design of the TPB provided structured and robust information about medicines reuse behaviour that will influence policy makers in the future if medicines reuse is to become a reality. Some of the findings from this thesis have already been disseminated through a journal publication as well as presentations at conferences.

## 7.3 Limitation of this thesis

Although the application of TPB was considered a strength in this study at the same time there were a few limitations in applying the TPB. First, not all constructs of TPB were used. The past behaviour and actual behavioural constructs were both not used. This is

mainly because it was not possible to measure the past or actual behaviour of reusing medicines as medicines are not yet allowed to be redistributed to other patients. In addition, the TPB as any other social cognitive model has received a lot of criticism regarding the conceptual, methodological and predictive ability of these models over the recent years (Armitage and Conner, 2001; Carpenter, 2010; and Donyai, 2012). However, it is important to mention here that TPB received less criticism compared to other social cognitive models (Armitage and Conner, 2001; Taylor et al., 2006; and Donyai, 2012). This could be considered an advantage of TPB over other social cognitive models rather than a limitation.

The second limitation, in this thesis is that the TPB model fit was poor and required a five modification indices. These modification indices suggested new relationships between the TPB constructs that was not reported or part of the TPB model proposed by Ajzen (Ajzen, 2006). Although, some of these relationships were reported by previous studies which used TPB model, it is difficult to determine how much significance these relationships hold and how unique they are to medicines reuse behaviour. This is simply because there have been no previous studies which applied TPB to understand medicines reuse behaviour to compare with. Finally, the use of an online questionnaire which would have excluded views from people with no internet access is considered another limitation in this thesis.

## 7.4 The potential impact of this thesis

The immediate pathway to impact is by disseminating the results of this thesis to other researchers and to the patient population. Some of this work has already been carried out but there is further scope to publish papers, attend conferences and write articles on social blogs about the findings.

The other pathway to impact will be by communicating the results of this thesis to policy decision makers in order to change the law regarding reusing medicines. Medicines are reused already in countries such as the USA therefore there is precedence for the reuse of medicines in a western economy. This thesis explored medicines reuse processes and identified the stakeholders perceived to be relevant to the discussion meaning that relevant parties can be approached in order to highlight the findings and explore willingness to bring about a change in the use of returned unused medicines. In addition to this, the results from this thesis can be used in order to develop targeted behavioural interventions should medicines reuse become a reality in the future. This means that should there be a need to encourage people to take part in reusing medicines in the future, the findings from this study can help inform the type of intervention that might best influence people's behaviours.

As it stands, normative beliefs were identified to be the strongest predictor of people's intention to reuse medicines. Therefore, in the future it may well be worth running a marketing campaign in relation to normative beliefs about medication reuse. But in addition to that, because all of the constructs of the TPB were in fact found to be statistically relevant to intentions to reuse medicines, a marketing campaign could also target these other construct. For example a campaign might target people's behavioural beliefs in terms advantages of reusing medicines, such as its beneficial direct impact on the environment and its economic impact, and indirectly through reducing accidental poisoning or self-medication when medicinal wastes are stockpiled at home. Or advertising by showing other people who advocate the reuse of medicines in the future might be

completed with pharmacists GPs, friend's family or partners because these groups were evidenced to be important in relation to people's decisions to reuse medicines.

In addition, findings relating to control beliefs would also help the process of bringing medicines reuse into reality. For example, it would be necessary to confirm that the returned unused medicines are safe and have maintained their quality to be reused. Also pharmacists would need to confirm that they are willing and have time and space to engage in medicine reuse processes. Finally, pharmaceutical companies would need to be involved so that they can develop the technology necessary for illustrating the safety and stability of returned unused medicines. This might be achieved, for example by placing a label, which is sensitive to light, temperature, and humidity on the packaging of medicinal products.

## 7.5 Future work

In principle, although people have concerns about medicines reuse, results from this thesis have confirmed that more than half intend, wanted, and were confident to reuse medicines in the future provided that certain caveats are put in place. These caveats include addressing concerns about safety and quality of the medicines that will be offered for reuse.

The participants interviewed recognised the problem of medicines waste and the potential for medicines reuse to minimise waste in the future. However, in identifying particular groups that might disapprove of medicines reuse, this study highlights the need to take account of vulnerable patient groups, and to address political challenges if medicines reuse were to become a reality. For example, the stance of the Association of the British Pharmaceutical Industry who represent the pharmaceutical industry in the UK remains unexplored. In addition, the participants expressed positive views about the involvement of

pharmacists in the medicines reuse process, which needs to be explored by pharmacy funding, professional and regulatory bodies. Interestingly, the people in this study commented only on financial incentives for patients and not for pharmacists. An alternative model not requiring CPs to quality check medicines for reuse was also suggested in this study, which partly mimics the American medication collection system (Cauchi, 2012).

However, US legislation dictates for "A state-licensed pharmacist or pharmacy to be part of the verification and distribution process" (Cauchi, 2012). The logistic of medicines reuse in the UK therefore needs to be further explored. Concerns about tampering and counterfeit medicines entering the medicines reuse supply chain might be addressed when the European Union directive on falsified medicinal products (EU2016/161) comes into force in the UK in 2019, since a supplementary Delegated Regulation requires marketing authorisation holders to add tamper evidence and a unique identifier to the outer packaging of medicinal products (Medicine and Health-care products Regulatory Agency, 2016). The role of heat, light and moisture sensitive monitoring labels as a means of addressing concerns about the degradation of returned medicines during storage remains to be investigated. Resolving the logistics of medicines reuse in the UK could support the international work of charities such as InterCare (InterCare, 2017) that rely on donated medicines.

Reusing medicine is a process which involves mainly patients, pharmacists, and to a lesser extent pharmaceutical companies. Therefore, the implementation of medicines reuse in the UK would rely heavily on guaranteeing the safety and stability of the returned medicines, people's uptake of this idea, and pharmacist's views and pharmaceutical company involvement. This thesis has provided a good insight from a patient point of view regarding

medicines reuse but views from other stakeholders are needed. A Delphi study by (McRae et al., 2016a) showed that pharmacists would be happy too to reuse medicines if certain factors are met.

The (McRae et al., 2016a) study provide an initial pharmacist views, and showed that pharmacists would be willing to redistribute medicines if certain criteria were met such as being solid dosage forms with a tamper evident seal. Other criteria expressed by pharmacists included liability protection, guidance from the professional regulator, that reused medicines must be supplied in new packaging, that technologies would need to be developed to indicate inappropriate storage, and that there must be public engagement on medicine redistribution. However, pharmacist views about reusing medicines may require further research and on a larger scale.

After achieving patient and pharmacist views and agreement to reusing medicines, exploring the involvement of pharmaceutical companies in medicines reuse would be the next step. Here it would be worth exploring whether companies would like to be involved in facilitating the medicines reuse process, for example, by placing a temperature sensitive label on the packaging, or repackaging the returned unused medicines, and taking the responsibility to ensure that the repackaged unused medicine is safe to be reused. This can be linked to the fact that in the UK, manufacturers will be required to place safety features on the packaging to check the safety of the returned unused medicines with respect to counterfeit issues using a unique identifier (a 2-dimension barcode) and an anti-tampering device no later than 9 February 2019. Although the purpose of adding the two safety measures is to prevent the entry of falsified medicines, potentially the two safety measures can be used to evaluate if the returned unused medicines can be suitable to be reused.

Further to this, the stability of the unused returned medicines and how the medication has been stored also needs to be confirmed before offering these medicines for reuse. This needs further research to investigate, for example if the pharmaceutical company will be able or willing to provide a technology (such as the temperature monitor alluded to above) that can check for medicines stability under different storage conditions.

Finally the modification indices indicated new relationships between the direct and indirect constructs of TPB that was not reported or part of the TPB model proposed by Ajzen (2006). These relationships provide an opportunity for further research and should be taken into consideration if TPB model will be used to capture pharmacist beliefs or other stakeholder beliefs about medicine reuse.

## 7.6 Medicinal waste in Jordan

In Jordan, medicines are obtained from community and hospital pharmacies. In the hospital settings, very limited interaction occurs between the pharmacist and the patient. Most hospital pharmacies still have antiquated dispensing windows where medicines are placed for patients to pick up (Al-Wazaify and Albsoul-Younes, 2005).

Although the Jordanian Food and Drug Administration (JFDA) drug classification and law in relation to drug dispensing is quite similar to those in the West, these laws are not strictly enforced or followed in the community pharmacies in Jordan (Al-Wazaify and Albsoul-Younes, 2005; and Yousef et al., 2008). A patient can buy any medicine without prescription, with the exception of controlled narcotics and major tranquillizers (e.g. benzodiazepines), which can only be dispensed upon the issue of a special prescription

signed by a registered physician (Al-Wazaify and Albsoul-Younes, 2005; and Albsoul-Younes et al., 2010).

There is no evidence or research study performed to explore people's disposal practices of unused medicinal waste in Jordan. Moreover, and unlike the UK, people in Jordan are not required or even told by health-care professionals to return their unused medicines to community or hospital pharmacies. The lack of awareness regarding the potential environmental effect of medicinal waste in Jordan may be a factor in facilitating unfavourable disposal practices such as throwing medical in general household waste, and flushing these down the sink or the toilet. Although there are anecdotal observations confirming these practices, still there is no evidence confirming or research investigating these unfavourable disposal practices of unused medicinal waste. The only evidence available is that unused medicinal wastes are stored in relatively large quantities in people's households (Al-Azzam et al., 2012; and Abushanab et al., 2013).

Medicinal waste in Jordan poses a risk to human health and also has economic impact. The risk to human health was referred to inappropriate storage condition with around 50 % of unused medicinal waste stored outside pharmacy cabinets in places accessible to children. These storage conditions could be considered unsafe and with potential risk of accidental poisoning especially with children (Abushanab et al., 2013). In addition, there is a high risk of self-medication of these unused medicinal waste as self-medication is reported to be a common practice among Jordanian people (42.5%) (Yousef et al., 2008). Self-medication was reported to be common with *antibiotics* as 39.5% of antibiotic users had used antibiotics without a prescription (Al-Azzam et al., 2007) and *medicines used for headache* (Al-Azzam et al., 2012).

In addition, the economic impact of medicinal waste is possibly more destructive to the brittle Jordanian economy. In the study by (Al-Azzam et al., 2012) the total extrapolated cost of unused medicinal waste that were stored in patients' homes in Jordan was around $30 million . Moreover, another study by Abushanab et al. (2013), showed that the total cost of unused medicinal waste that were stored at patient home from one city (Amman, the capital city of Jordan) was $12 million. Those figures are the only evidenced and reported in the literature. There is no research investigating the environmental impact or people's disposal practices of medicinal waste in Jordan.

Only two studies reported in the literature have investigated medicinal waste in Jordan. However, the causes as well as the interventions to reduce medicinal waste in Jordan have not been studied. The researcher HA will apply the research skills and knowledge developed during the PhD and from this research to further explore the causes of medicinal waste, and possible interventions to reduce medicinal waste in Jordan (the researcher HA's home country).

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# APPENDICES

## Appendix 1 Summary of research studies evaluating the therapeutic classes and dosage forms of medicinal waste

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| 2015 | Gracia-Va´squez*et al*. | Mexico; nine cities of Monterrey | Unused/expired drugs were returned from households and collected from 85 community pharmacy centre over 12 months from March 2012 to February 2013. | Random sample of 22,140 items, 30 % of total drugs collected over 12 month) as 70% were unable to be classified. | Not studied. |
| 2008 | Braund *et al*. | New Zealand | Over a five-week period medications returned to two collection point pharmacies and questionnaire was completed by returners. | 163 returns, comprising of 1399 items, with only 126 returned questionnaire. | The majority of those returning medications fall within the age range of (61–80) years. |
| 2007 | Braund *et al*. | New Zealand; Otago Pharmacies | Medications returned unsolicited to Otago pharmacies over a 9 months period, from 1st April to 31st December 2005. | A random sample (159kg, 12%) of the 1294kg of medications returned for destruction over a nine-month period from the Otago region were identified | Not studied |
| 2009 | Braund *et al*. | New Zealand; Hutt Valley District Health Board. | A Disposal of Unwanted Medication Properly (DUMP) campaign was conducted for 4 weeks in November 2007 in 31 community pharmacies. Questionnaire was completed by the returners. | Of the total 1,605 bags returned over 4 weeks for disposal, only 329 bags (20%), containing a total of 1,253 items were fully analysed. Only 653 questionnaire were completed (41%) | The age distribution of the patients with unused medications was <20 (8%), 21–40 (13%), 41–60 (28%), 61–80 (40%) and > 81 years (11%). |
| 2010 | Gibbs *et al*. | New Zealand; Nelson Bays region. | A Disposal of Unwanted Medication Properly (DUMP) campaign was conducted for 5 weeks in November and December 2009) and for 3 weeks | Of the 6500 DUMP bags distributed across the Nelson Bays region, 1244 bags were returned (response rate 19%), with an | Not studied. |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| | | | afterwards. Surveys were completed in 379 bags. | average of 7 items per bag (number of items returned 8609). | |
| 2009 | James *et al*. | New Zealand: Taranaki region (around 37,000 households) | Unused medications returned for disposal to the 24 community Pharmacies over 6 weeks. | 716 individuals returned 3777 items of unused medications. . Of the 3777 information for the amount issued and returned was complete for 2704.The majority (51%) of returns contained 75–100% of the original dispensed amount of medication. | Not studied. |
| 2005 | Langley *et al*. | United Kingdom; East Birmingham | Unused medications returned to 8 community pharmacies and 5 general practices (GP) surgeries over 4 weeks each (4 weeks during August 2001, 4 weeks during March 2002, respectively). | A total of 114 returns; 24 (21.1%) to GP surgeries and 90 (78.9%) to community pharmacies. The total returns comprised 340 items, of which 42 (12.4%) were returned to GPs and 298 (87.6%) to community pharmacies. | Older patients (60 years and over) returned 61.4% of items with 24.6% of returns coming from patients aged 30–59 years and 5.3% of returns originating from patients under 30. Ages were not recorded for 8.7% of returns. |
| 2007 | Mackridge *et al*. | United Kingdom; Eastern Birmingham Primary Care Trust (PCT) | Unused medications returned to pharmacies and GP surgeries were collected over 8 weeks in May and June 2003 in Eastern Birmingham Primary Care Trust (PCT). Three-quarters of the PCT sites participated, 51/60 (85%) pharmacies and 42/61 (70.5%) GP surgeries. | 934 return events were made from 910 patients (190 GP surgeries, 744 pharmacies), comprising 3765 items (431 GP surgeries, 3334 pharmacies) and totalling 4934 individual packs. | The mean age of 63.5+0.78 years (10 months to 99 years) and there was no detectable correlation between the mean number of items returned per patient and their age |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| 2008 | Bradley M | United Kingdom; Cumbria | A medicine waste audit in community pharmacies of Cumbria where each pharmacy asked to analyse 20 returns of unused medicines. Further qualitative data was collected by interviewing the patients and their representatives. | A total 4,563 items was received from 87 community pharmacies across Cumbria. | Not studied |
| 2010 | Trueman *et al*. | United Kingdom | Unused medications returned to 114 pharmacies (51 from London/urban, 32 from North-West/rural & urban, 24 from Yorkshire & Humber/rural & urban, 7 from West-Midlands/rural) from 5 primary care trusts. | In total, 8626 items were reported as returned with 7,500 of the returned items identified and coded for analysis. | Not studied |
| 2008 | Coma *et al*. | Spain; Barcelona | Unused medications returned to random sample of 118 community pharmacies in Barcelona invited to participate, 38 (32%) agreed to participate. Data were collected from February to April 2005. Questionnaire was completed by the returners. | In total, 1,176 packages were returned by 227 patients. The majority were medicines (96.6%), and the rest were medical supplies or devices (0.5%) or other products sold in the community pharmacy (2.9%; e.g., personal care, nutrition). Most medicines returned were drugs for human use (99.8%) and only 0.2% were for veterinary use. | (54.6% women, 64 ± 20 years-old) |
| 2015 | Law *et al*. | USA; Southern California | Cross sectional, observational two phases study was conducted using a convenience sample in Southern | Phase I: A total of 539 prescription medications were reported, with an average of 4 per household. | Phase I: Average household age was 36.4 years, but not described |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| | | | California. In Phase I, a web-based survey was conducted at one health sciences institution; and in Phase II, a paper-based survey at drug take-back events. | Approximately 7% of the unused medications were expired, and 30% were brand name.<br>Phase II: of the 776 unused medications returned for disposal, 311 (40%) medications were brand name. Nearly two-thirds (66.2%) were expired, discontinued by the physician (25%), or became unused after the patient indicated feeling better (17.6%). | in Phase II which the drug take back program. |
| 2004 | Garey *et al*. | USA; Houston, Texas. | Unused medications returned to community pharmacy during "Medicine Cabinet Clean up Campaign" over 6 months between April and September 2002 (pilot study). | In total, 1315 medication containers were returned to the community pharmacy. 63% of returned medications were dispensed between 2000 and 2002, 31% from 1995 to 1999, and 6% before 1995. | Not studied |
| 2015 | (Maeng et al., 2016) | USA; Regional health plan in Central Pennsylvania. | Telephone survey conducted by a survey research centre. | Not studied | Not studied |
| 2014 | Vogler *et al*. | Austria; Vienna | Unused medications collected from household garbage in all districts of Vienna between (12/10-24/11) 2009. | In total, 152 packs were identified from manually investigated sample from household garbage in Vienna. | Not studied |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| 2013 | Chien *et al*. | Taiwan; Shuang-Ho university teaching hospital. | Discarded drugs were collected from the Drug Discarding Bin at the Shuang-Ho Hospital over 4 weeks. | A total of 98kg (51,972) discarded medications collected from the hospital Drug Discarding Bin. | Not studied |
| 2013 | Abushanab *et al*. | Jordan; Amman | Cross sectional survey using pre-piloted questionnaire was used in the interview of 219 households in 9 areas of Amman to about the types of drugs stored at home conducted between November 2009 and April 2010. | From the 2393 drug product were presented in surveyed household, 24.99% was considered as drug waste (Drug wastage, calculated as the sum of drug products that had expired 10.91%, had no clear expiration date 1.84%, or which had never been used since dispensing 15.04%(EWFD)). | Age of the interviewee (years) 42.15 ± 14.67 |
| 2012 | Al - Azzam *et al*. | Jordan; North of Jordan particularly Irbid | Validated questionnaire was administered to 435 households selected randomly from different areas in the north of Jordan (particularly in Irbid governorate) in the period from April 2007 and until August 2007. | Of the total of 2835 medication items found in the 435 selected houses, 65.3% were in use, and 34.7% were not in use. | Age of the interviewee (years) 36.4 (±11.9) |
| 2002 | Abou-Auda HS | 5 regions in Saudi Arabia and other Gulf countries (Kuwait, | A questionnaire was administered to a total of 1641 households participated in the study (1554 in Saudi Arabia; 87 in other countries). | A total of 12,463 drug products were found in 1554 households in Saudi Arabia. Among the 87 households surveyed in the 4 other Gulf countries, 616 drug products were found. | Not studied |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| | | UAE, Qatar, and Oman) | | | |
| 2007 | Al-Siyabi *et al*. | Oman; Sultan Qaboos University Hospital (SQUH) | Observational study of returned unused medicines to the pharmacy at SQUH between February and June 2003. | A total of 1,171 items (medications) were returned to the pharmacy at SQUH, among these, 99 drugs were excluded. Medicines were included only if they had SQUH patients' labels. And any items without SQUH patient' labels were excluded from study. | Not studied |
| 2004 | Wongpoowarak *et al*. | Thailand; Songkhla | A cross-sectional survey of unused medicines of a random sample of 931 households in the Songkhla. Of the 931 households surveyed and interviewed by using structured questionnaire there were 453 (48.7%) where at least one person reported having unused medications. | A total of 1,004 unused medication (items) were identified from 523 respondents who had unused medications in 453 households. Nine items could not be identified because their physical appearance did not match that of any known medication. Thus 995 items were included. | Gender:<br>Male 224 (42.8%).<br>Female 299 (57.2%).<br>Age:<br>0–9 years 167 (31.9%).<br>10–19 years 52 (10.0%).<br>20–29 years 66 (12.6%).<br>30–39 years 76 (14.5%).<br>40–49 years 64 (12.2%).<br>50–59 years 40 (7.7%).<br>≥60 years 58 (11.1%). |
| 2013 | Sooksriwong *et al*. | Thailand; 4 regions of Thailand: Bangkok, Chiang Mai, Khon Kaen, Mahasarakha | Structured questionnaire developed to survey 357 households which were interviewed and during January and March 2011. 46% in Bangkok and 54% in upcountry | 2,208 drug items were found in 357 households. 952 items (43%) of these drug items were dispensed by public hospitals, 750 items (34%) from drug stores, 163 items (8%) from private hospitals and 210 items (10%) from others. | Not studied |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| | | m and Songkla | | | |
| 2011 | El-Hamamsy A | Egypt; Cairo | Pilot study where all drugs returned unused to 20 community pharmacies in Cairo over period of one month (April 2009). | A total of 541 drugs were returned and collected over one month. | Not studied. |
| 2012 | Ibrahim *et al*. | Egypt; Alexandria | A cross-sectional descriptive study where all drugs returned unused into randomly selected 60 pharmacies in Alexandria over a period of one month during march 2011. | A total of 657 drugs were returned from 600 patients to the 60 pharmacies over one month. | Males constituted the higher percentage of the participants 56.7%.<br>Elderly having 60 years or above constituted the highest proportion of the sample 28.3%, while the lowest percentage 4.0% was within the age group (10 to less than 20). |
| 2010 | Guirguis *et al*. | Australia; St Vincent's Hospital, Melbourne | Retrospective audit looked at all expired medications or those no longer needed were collected at St Vincent's Hospital, Melbourne over 2 months (July and August of 2008) | A total of 293 items were collected from 40 patients recruited over 2 months. | Older than 65 years of age. |
| 2014 | Kagashe *et al*. | Tanzania; tertiary hospital in Dar ES-Salaam city | Cross sectional study carried out at a tertiary hospital in Dar es Salaam city Tanzania where patient files were analysed for last admission treatment information for the year 2012. | About 56.3% of medicines prescribed were dispensed to patients. Out of the total 1418 dispensed drugs, 730 medicines were wasted. | The mean age of the study population was 44 years, with minimum age of 11 years and maximum of 88 years.<br>Medicines wastage was reported from female more than in male (404 (55.7%) vs. 326 (47.1%), respectively) |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| 2007 | Abahussain *et al.* | Kuwait; Kuwait city | Municipal collection program of unwanted medicines from households in Kuwait City. | Sample of 200 households in Kuwait received an educational letter and special plastic bags in which to place unwanted medicines to be collected by the municipality. A second convenience sample of an additional 14 households in Kuwait received the same educational letter together with a face-to-face interview and assistance in collecting unwanted medicines. | Not studied |
| 2013 | Aditya S | India; dental hospital in North India. | Descriptive cross sectional survey of dental students based on a structured questionnaire format) was carried out in a teaching dental hospital in North India | 244 students, with 8 students were excluded due to incomplete forms only 236 were included. | Age of participants from 20-40 years. |
| 2011 | Gupta *et al*. | India; Greater Noida City | A simple randomised prospective survey study which was carried out for a period of six months in selected areas of Greater Noida City. Randomly selected 102 houses were visited to educate and assess the people about Home Medicine Cabinet. | A total of 392 people were surveyed in 92 houses with exception of 10 houses. | Of the total 392 people surveyed: The male vs. female for those with age >12 years is 144 (36.73%) vs.133 (33.93%), respectively. The male vs. female for those with age <12 years is 69 (17.6%) vs.46 (11.74%), respectively. |

| Year of study | Author (s) | Country/ Settings | Research instrument | Sample | Demographics |
|---|---|---|---|---|---|
| 2009 | Ali *et al*. | Malaysia; Universiti Sains | A prospective descriptive, cross-sectional survey was conducted from February to June 2005 in the Universiti Sains, Malaysia. | A total of 481 single female respondents were targeted for a questionnaire-based survey on randomly sampled students. A total 1724 different types of medicines were found with average number of 4 medicines found per student. | Respondent were only females ages varied from 19 to 54 years old. 89.2% (n=429) of the students were categorised in the 19-24 years age category while 8.7% (n=42) were aged between 25-30 years old. The remaining 2.1% (n=10) were aged between 31-54 years. |
| 2014 | Aboagye *et al*. | Ghana | The study was conducted over selected areas in Ghana with a questionnaires were randomly issued out from the 13th to the 20th of December, 2009. | Out of the 200 questionnaires sent out, 180 were retrieved and analysed. | The majority of the respondents 62.8% (113/180) were between the ages of 21 – 40 years, and the minority 5.6% (10/180) were above 61years. A total of 99 (55%) of the respondents were males corresponding to 81(45%) females. |

## Appendix 2 Summary of research studies evaluating the therapeutic classes and dosage forms of medicinal waste

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| 2015 | Gracia-Va´squez *et al*. | Mexico; nine cities of Monterrey | The most commonly returned medications were of Non-steroidal anti-inflammatory followed by Cardiovascular drugs. Non-steroidal anti-inflammatory drugs 16.11%.<br>Cardiovascular drugs 14.21% (Anti-hypertensive 55%).<br>Gastrointestinal drugs 11.43%.<br>Antibacterial drugs 10.05%.<br>Respiratory system drugs 8.75%.<br>Neurological drugs 6.13% (anti-depressant 34%).<br>Dietary supplement 5.23%.<br>Anti-diabetic drugs 4.34 %.<br>Miscellaneous drugs3.79 %.<br>Hypolipemic drugs 3.67%.<br>Anti-parasitic drugs 2.48%.<br>Hormonal drugs 1.89%.<br>Anti-micotic drugs 1.84%.<br>Steroidal anti-inflammatory drugs 1.72%.<br>Dermatological drugs 1.71%.<br>Ophthalmic drugs 1.64%.<br>Anti-viral drugs 1.53%. | The majority of unused/expired medications collected (73 %) was in solid dosage form (tablets, capsules, granules, powders, and lozenges).<br>20 % were liquid pharmaceutical forms (syrups, injections, eye drops, suspensions, emulsions, and lotions). 6 % were semisolid (ointments, creams, gel, paste and suppositories).<br>1 % were other forms, such as metered dose inhalers, sprays, patches, strips, and chewing gums | Unable to describe respondent demographic information. |
| 2008 | Braund *et al*. | New Zealand | The most commonly returned medications were of the nervous system | Only oral dosage form reported. | Small number of returned unused medication. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Nervous system drugs, followed by Alimentary tract and metabolism.<br>Nervous system drugs 17%.<br>Alimentary tract and metabolism system drugs14%.<br>Cardiovascular system drugs 12%.<br>Respiratory system and allergies 11%.<br>Musculoskeletal system drugs 11%.<br>Infections – agents for systemic use 9%.<br>Blood and blood-forming organs 8%.<br>Oncology agents and immunosuppressants 6%.<br>Genitourinary system 5%.<br>Dermatologicals 3%.<br>Sensory organs 2%, and Hormone preparations – systemic 2%. | | |
| 2007 | Braund *et al*. | New Zealand; Otago Pharmacies | The returned medications were not classified by therapeutic group, but by generic name.<br>The most commonly returned tablet was paracetamol (9% of all tablets returned).<br>The most commonly returned capsule was omeprazole 20mg (8% of capsules), additionally omeprazole 40mg accounted for a further 5% of all capsules. | There were 65 907 tablets returned and 7599 capsules returned.<br>Others include injections, inhalers, eye drops, creams, gels, ointment, test strips, liquids, and suppositories. | Unable to describe respondent demographic information.<br>Unable to report unused medicines as therapeutic group. |
| 2009 | Braund *et al*. | New Zealand; | The predominant therapeutic group was drugs affecting the Nervous system. But | Oral solid forms (tablets and capsules) were counted. | The chosen sample of the total returned unused medicine was |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | Hutt Valley District Health Board. | individually diclofenac sodium and ibuprofen was the most returned medications respectively.<br>Nervous system drugs 19%.<br>Alimentary tract & metabolism 13%.<br>Cardiovascular system 12%.<br>Musculo-skeletal system 11%.<br>Respiratory system & allergies, and Miscellaneous 8%.<br>Blood & Blood forming organs7%, Dermatological, and Anti-infective 7%.<br>Genitourinary3%, Hormones 3%. | Liquid medications were quantified by the amount left in the original container, semisolid preparations were estimated as a proportion of original container. Inhalers were recorded as either full, half-full or empty.<br>Anything almost empty was excluded from the analysis. | around 20%, which maybe not representative to the whole sample. |
| 2010 | Gibbs *et al*. | New Zealand; Nelson Bays region. | The most common returned (top 20) by quantities (individual unit) were (n:435, 397):<br>Salazopyrin 94,271 tablets.<br>Paracetamol 23,251 tablets.<br>Lactulose 11,324 mL.<br>Aspirin 10,047 tablets.<br>Simvastatin 7,380 tablets.<br>Diclofenac 7,014 (mixed preparation)<br>Prednisolone 7,004 tablets<br>Metoprolol 6,627 tablets.<br>Warfarin 6,590 tablets.<br>Furosemide 6,117 tablets.<br>Lemnis fatty cream 6,095g.<br>Cilazapril 5,687 tablets. | Oral solid forms (tablets and capsules) with tablet as most common returned dosage form.<br>Oral liquid forms.<br>Cream, and ointment. | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | (Paracetamol & Codeine) preparation 5,003 tablets. Ibuprofen 4,873 tablets. Codeine 4,794 tablets. Laxsol 4,267 tablets. Morphine 4, 107 (mixed preparations). Emulsifying ointment 4,030 g, Quinapril 3,890 tablets. | | |
| 2009 | James *et al*. | New Zealand: Taranaki region (around 37,000 households) | The predominant therapeutic group was drugs affecting Nervous system. But individually, paracetamol (acetaminophen) was the most returned medication respectively.<br>Nervous system drugs (n = 658, 24.3%).<br>Cardiovascular system (n = 559, 20.7%).<br>Alimentary tract & metabolism (n = 529, 19.6%).<br>Blood & Blood forming organs (n = 283, 10.5%).<br>Respiratory system & allergies (n = 190, 7.1%). | Not studied. | Unable to describe respondent demographic information.<br><br>Also due the different policies for collection and disposal of medicines, the majority of unused medicines were disposed into landfills and water system, which may means that the returned amount may be underestimate of the extent of unused medicines. |
| 2005 | Langley *et al*. | United Kingdom; East Birmingham | The predominant therapeutic group was drugs affecting cardiovascular system.<br>Cardiovascular system drugs 28.5%.<br>Central Nervous system drugs 18.8%.<br>Respiratory system drugs 14.7%.<br>Gastrointestinal drugs 10.6%.<br>Endocrine system drugs 5.6%<br>Musculo-skeletal and joint disease drugs 5% | Tablet or capsule, oral liquid, cream or ointment and inhalers. | Sample size and the number of return is small which make it difficult to extrapolate the result to whole united kingdom. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Anti-infective Drugs 4.7%.<br>Eye Drugs 3.5%.<br>Nutrition & blood drugs 2.1%<br>Skin drugs 1.8%.<br>Obstetrics, gynaecology, and urinary-tract disorders 1.5%<br>Nutrition and blood & unknown 1.2%.<br>Malignant disease and Immunosuppression 0.9%. | | |
| 2007 | Mackridge and Marriott | United Kingdom; Eastern Birmingham Primary Care Trust (PCT) | The predominant therapeutic groups were drugs affecting cardiovascular system and drugs acting on the central nervous system, respectively. The most commonly returned drugs were aspirin (102 items), co-codamol (98 items), salbutamol (96 items), furosemide (90 items) and glyceryl trinitrate (78 items).<br>Drugs affecting cardiovascular system (1003 items, 26.6%). Drugs acting on the central nervous system (884 items, 23.5%).<br>Drugs affecting respiratory system (358 items, 9.5%) and gastrointestinal system (358 items, 9.5%).<br>Drugs affecting endocrine System (257 items, 6.8%).<br>Drugs treating Musculoskeletal and joint diseases (235 items, 6.2%). | Tablet or capsule, oral liquid, cream or ointment and inhalers. | The author reported that this study did not attempt to estimate the quantities of unused medicines at patient's home, as a result, it is more likely that the unused medicines from primary care was underestimated. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Anti-infective drugs (165 items, 4.4%).<br>Drugs for skin (124 items, 3.3%).<br>Drugs for Nutrition and blood (116 items, 3.1%).<br>Drugs for eye (65 items, 1.7%).<br>Obstetrics, gynaecology, and urinary-tract disorders (59 items, 1.6%).<br>Drugs for Ear, nose, and oropharynx (58 items, 1.5%) & others (58 items, 1.5%).<br>Drugs for Malignant disease and immunosuppression 20 items, 0.5%).<br>Drugs for Anaesthesia (5 items, 0.1%). | | |
| 2008 | Bradley M | United Kingdom; Cumbria | The greatest value of returned of medicines were from Cardiovascular and Central nervous system categories (BNF), total number of returns (n=4562):<br>Cardiovascular (n=1232).<br>Central nervous system (n=1149).<br>Gastrointestinal system (n=468)<br>Endocrine (n=334).<br>Respiratory (n=307).<br>Anti-infective (n=250).<br>Musculoskeletal and joint (n=228).<br>Nutrition and blood (n=141).<br>Skin (n=134).<br>Others (n=319) | Not studied | It is an audit report with a result from Cumbria/north west of England which may not representative of whole United Kingdom and may underestimated the extent of unused medicines. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| 2010 | Trueman *et al*. | United Kingdom | Coding was based on guidance provided by the Royal Pharmaceutical Society of Great Britain/BNF. The most common retuned medication was for cardiovascular and central nervous system.<br>Cardiovascular system drugs (1950 items, 22.6%).<br>Central nervous system drugs (1907 items, 22.11%).<br>Gastro-intestinal system drugs (828 items, 9.6%).<br>Respiratory system drugs (528 items, 6.12%).<br>Endocrine system drugs (518 items, 6.01%).<br>Endocrine system drugs (518 items, 6.01%).<br>Anti-infective drugs (444 items, 5.15%).<br>Musculoskeletal, joint disease drugs (364 items, 4.22%).<br>Nutrition and Blood drugs (249 items, 2.89%).<br>Skin drugs (192 items, 2.23%).<br>Eye drugs (129 items, 1.5%).<br>Ear, nose, oropharynx drugs (68 items, 0.79%). | Not studied | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Malignant disease & immuno-suppression drugs (53 items, 0.61%).<br>Wound management drugs (34 items, 0.39%).<br>Borderline substances (25 items, 0.29%).<br>Drugs for Anaesthesia (9 items, 0.10%). | | |
| 2008 | Coma *et al*. | Spain; Barcelona | The predominant therapeutic groups were drugs affecting Alimentary tract and metabolism, Nervous system, Cardiovascular system, respectively. All drugs were categorised according to Anatomical Therapeutic Chemical (ATC) system/code of the World Health Organisation (WHO).<br>Alimentary tract and metabolism drugs (215 items, 18.3 %)<br>Nervous system drugs (214 items, 18.2%).<br>Cardiovascular drugs (137 items, 11.6%).<br>Respiratory system drugs (103 items, 8.8%)<br>Musculo-skeletal system drugs (88 items, 7.5%).<br>Dermatological drugs (85 items, 7.2%).<br>Anti-infective drugs (77 items, 6.5%). | Not studied | Unable to describe the respondent demographic information clearly |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Missing drugs (could not be coded according to the ATC system), (66 items, 5.6%).<br>Sensory organs drugs (63items, 5.4%).<br>Drugs affecting Genitourinary system & sex hormones (50 Items, 4.3%).<br>Drugs affecting Blood & blood forming organs (32 items, 2.7%).<br>Antineoplastic and immune-modulating drugs (22 items 1.9%).<br>Systemic hormonal preparations excluding sex hormones and insulins, (17 items, 1.4%).<br>Various Drugs (5 items, 0.4%).<br>Anti-parasitic products, insecticides and repellents (2items, 0.2%). | | |
| 2015 | Law *et al*. | USA; Southern California | Approximately 2 of 3 prescription medications were reported unused.<br>In phase I, pain medications (23.3%) and antibiotics (18%) were most commonly reported as unused.<br>In Phase II, 17% of medications for chronic conditions (hypertension, diabetes, cholesterol, heart disease) and 8.3% for mental health problems (antidepressants/antipsychotic/Anti-convulsant) were commonly reported as | Tablets, pills, capsules and liquid preparations. | Use of a web-based survey may limited the accessibility of this study to people without computer and Internet access at home, which may to some extent underestimated the extent of unused medicines.<br><br>Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | unused. 7% painkillers, and 4% electrolytes and dietary supplements. | | |
| 2004 | Garey *et al*. | USA; Houston, Texas. | The predominant therapeutic group was non-steroidal anti-inflammatory drugs/pain.<br>Non-steroidal anti-inflammatory drugs/pain 25%.<br>Drugs for cough/cold/allergy 15%.<br>Anti-infective drugs 11%.<br>Cardiovascular drugs 10%.<br>Respiratory drugs 9%.<br>Neurological drugs 8%.<br>Dermatological 7% and Gastrointestinal 7%. | Oral medications (capsules or tablets) were most commonly returned (64%), followed by liquid (12%), creams (11%), inhalers (7%), or miscellaneous (6%; e.g., eye glasses, hearing aid batteries, medical equipment). Approximately 17 000 oral pills were collected during the study period. | Unable to describe respondent demographic information. |
| 2016 | (Maeng et al., 2016) | USA; Regional health plan in Central Pennsylvania | The predominant therapeutic group was Pain medication (15%), hypertension (14%), antibiotics (11%), and psychiatric disorders (9%) | Not studied | Unable to describe respondent demographic information. |
| 2014 | Vogler *et al*. | Austria; Vienna | The predominant therapeutic group was cardiovascular drugs.<br>Cardiovascular drugs (36 packs, 23.7%).<br>Musculoskeletal system drugs (17 packs, 11.2%).<br>Nervous system drugs (16 packs, 10.5%)<br>Alimentary tract & metabolism 15 packs, 9.9%). | Oral medications were the most commonly founded 86.8% (usually solid oral), followed by dermal 6.7%, parental 4%, nasal 0.7% pulmonary0.7%, eye 0.7% Dental 0.7%. | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Anti-infective drugs for systemic use (5 packs, 3.3%).<br>Drugs for Blood & blood forming organs (4 packs, 2.6%).<br>Genitourinary system drugs & sex hormone (2 packs 1.3%) and Dermatological drugs (2 packs 1.3%).<br>Other ATC code or not attributable (45 packs, 29.6%). | | |
| 2013 | Chien *et al*. | Taiwan; Shuang-Ho university teaching hospital. | Among the discarded medications, gastrointestinal drugs were at the top of the list of all discarded medications. The analysis of discarded and unused drugs revealed that<br>Strocain (oxethazaine, polymigel) was on top of the list, followed by Glucobay (acarbose), Mopride (mosapride) and Loditon (metformin).<br>Gastrointestinal drugs 25.93%.<br>Cardiovascular drugs 22.49%.<br>Anti-inflammatory drugs 12.15%.<br>Anti-diabetic drugs 9.49%.<br>Cold medicines 6.83%.<br>Psychiatric drugs 5.44%.<br>Respiratory drugs 2.16%.<br>Rheumatological drugs 1.52%.<br>Antimicrobial drugs 1.42%.<br>Others 9.19%. | Tablets, bottles and tubes | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Health foods 3.38%. | | |
| 2013 | Abushanab *et al*. | Jordan; Amman | Alimentary tract & metabolism drugs were the most commonly found in household (both used and unused).<br>Stored drug products were classified by ATC code of WHO.<br>Alimentary tract and metabolism 519 (20.7%).<br>Nervous system 370 (17.3%).<br>Musculoskeletal system 313 (12.9%).<br>Respiratory system 291 (12%).<br>Cardiovascular system 256 (10.9%).<br>Anti-infective for systemic use 252 (10.6%).<br>Dermatological 149 (5.4%).<br>Blood and blood forming organs 109 (4.6%).<br>Genitourinary system and sex hormones 31 (1.1%).<br>Systemic hormonal preparations, excl. sex hormones and insulin 18 (1.1%).<br>Anti-parasitic products, insecticides and repellents 13 (0.7%).<br>Anti-neoplastic and immune-modulating<br>Sensory organs 63 (2.5%) agents 8 (0.3%). | Not studied | Studied the medication stored at home the estimated the unused wasted medicine as the sum of drug products that had expired, had no clear expiration date, or which had never been used since dispensing. So not directly investigate the unused wasted medicine. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| 2012 | Al - Azzam *et al*. | Jordan; North of Jordan particularly Irbid. | Central nervous system drugs were found to be the most common, followed by anti-infective agents<br>The most common individual medications found were amoxicillin, paracetamol, metronidazole, antihistamines, hypoglycaemic medications, and adult cold medications.<br>Central nervous system drugs (713 items, 25.2%).<br>Anti-infective agents (493 items, 17.4%).<br>Musculoskeletal agents (381 items, 13.4%)<br>Respiratory system agents (348 items, 12.3)<br>Gastro-intestinal agents (301 items, 10.6%)<br>Cardio-vascular agents (216 items, 7.6%)<br>Endocrine system agents (200 items, 7.0%)<br>Nutrition agents (127 items, 4.5%)<br>Eye, Ear, Nose and Skin agents (56 items, 2.0%). | Tablets (1794 items 63.3%)<br>Capsules (332 items, 11.7%)<br>Syrups (250 items, 8.8%)<br>Suspensions (201, 7.1%)<br>Suppositories (117 items 4.1%)<br>Creams / ointments / gels (43 items, 1.5%)<br>All forms of injections (53 items, 1.9%)<br>Drops /nasal or oral puff (45 items, 1.6%) | Sample was selected from northern Jordan which may not representative of the whole Jordan |
| 2002 | Abou-Auda HS | 5 regions in Saudi Arabia and | Medications were also categorized according to their pharmacologic or therapeutic class using the classification | Not studied | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | other Gulf countries (Kuwait, UAE, Qatar, and Oman) | of drugs adopted in the Saudi National Formulary (SNF).<br><br>Respiratory system drugs Saudi Arabia 2095 (16.8%), other gulf countries 94 (15.3%).<br>Central nervous system drugs Saudi Arabia 2050 (16.4%), other gulf countries 84 (13.6%).<br>Antibiotics Saudi Arabia 1779 (14.3%), other gulf countries 111 (18.0%).<br>Gastrointestinal drugs Saudi Arabia 1382 (11.1%), other gulf countries 60 (9.7%).<br>Miscellaneous Saudi Arabia 847 (6.8%), other gulf countries 57 (9.3%).<br>Nutrition and blood drugs Saudi Arabia 823 (6.6%), other gulf countries 24 (3.9%).<br>Musculoskeletal/joints drugs Saudi Arabia 790 (6.3%), other gulf countries 52 (8.4%).<br>Skin drugs Saudi Arabia 735 (5.9%), other gulf countries 33 (5.4%).<br>Ear, nose, throat drugs Saudi Arabia 553 (4.4%), other gulf countries 26 (4.2%).<br>Cardiovascular drugs Saudi Arabia 465 (3.7%), other gulf countries 60 (9.7%). | | |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Eye drugs Saudi Arabia 398 (3.2%), other gulf countries 25 (4.1%).<br>Endocrine drugs Saudi Arabia 375 (3.0%), other gulf countries 16 (2.6%).<br>Obstetric/gynaecologic and/or urinary drugs Saudi Arabia 140 (1.1%), other gulf countries 12 (1.9%).<br>Cytotoxic drugs Saudi Arabia 31 (0.2%), other gulf countries 0 (0.0%).<br>Total drugs Saudi Arabia 12,463 (100%), other gulf countries 616 (100%).<br>The mean medication wastage was estimated to be 25.8% Saudi Arabia and 41.3% other gulf countries. | | |
| 2007 | Al-Siyabi *et al*. | Oman; Sultan Qaboos University Hospital (SQUH) | Cardiovascular drugs were the most common pharmacological group of returned drugs. The drugs were classified according to the classification index of the British National Formulary.<br>Cardiovascular drugs 24%.<br>Central nervous system drugs 14%.<br>Anti-infective drugs 13%.<br>Endocrine drugs 10%.<br>Nutrition 9%.<br>Gastro-intestinal drugs 8%, and Musculoskeletal system drugs 8%.<br>Respiratory system drugs 5%. | Not studied | Unable to describe respondent demographic information.<br><br>As it included only medicines with SQUH labels, others missed, as this may and underestimated the extent of unused medicines. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Immunosuppressant drugs 3%.<br>Eye/Ear drugs 2%. | | |
| 2004 | Wongpoowarak *et al*. | Thailand; Songkhla | Musculoskeletal system drugs were the most common pharmacological group of returned drugs. The medications were pharmacologically classified using MIMS Thailand, a standard reference source.<br>Musculoskeletal system drugs (229 items, 23.3%).<br>Anti-infective drugs (189 items, 19.2%).<br>Respiratory system drugs (166 items, 16.9%).<br>Gastrointestinal system drugs (129 items, 13.1%).<br>Allergy and immune system drugs (91 items, 9.2%).<br>Vitamins and minerals (68 items, 6.9%).<br>Others (EWFD, 2008) (54 items, 5.5%).<br>Central nervous system (37 items, 3.8%).<br>Cardiovascular (21 items, 2.1%). | Oral dosage forms compromised 95.6% (951 items).<br>Oral tablets or capsules (636 items, 63.9%).<br>Oral liquids (311 items, 31.3%).<br>Eye drops (23 items, 2.3%).<br>Topical liquids (14 items, 1.4%).<br>Creams (5 items, 0.5%).<br>Oral powders (4 items, 0.4%).<br>Inhalers (2 items, 0.2%). | This study was a snapshot study, as studied population was one of 14 provinces in southern Thailand. |
| 2013 | Sooksriwong *et al*. | Thailand; 4 regions of Thailand: Bangkok, Chiang Mai, | Of the total of 2,208 drug items found in household surveys into 5 groups of the mostly found drugs. These were 343 non-opioid analgesics and antipyretic drugs, 188 antacids, anti-reflux agents and anti-ulcer, 180 non-steroidal anti- | Not studied | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | Khon Kaen, Mahasarakham and Songkla | inflammatory drugs (NSAIDs), 127 antihistamine and anti-allergic and 119 anti-diabetic drugs.<br>Top 5 of the most found rarely or unused drugs, classified as leftover medicines, were NSAIDs (49 items), penicillins (38 items), GIT regulators, Antiflatulents (36 items).<br><br>Of the total of 2,208 drug items found in household, 82 items (3.7%) and 45 items (2.0%) of drugs were already expired and deteriorated respectively. | | |
| 2011 | El-Hamamsy A | Egypt; Cairo | The returned medications were classified according to the British National Formulary (BNF). Antibiotics were the most common pharmacological group of returned medications.<br>Antibiotics (109 items, 20.15%).<br>Gastro-intestinal system drugs (88 items, 16.27%).<br>Cardiovascular system drugs (58 items, 10.72%).<br>Respiratory system drugs (44 items, 8.13%).<br>Nervous system drugs (39 items, 7.20%). | Not studied. | Unable to describe respondent demographic information. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Analgesics and anti-inflammatory (38 items, 7.02%).<br>Dermatological drugs (35 items, 6.47%).<br>Blood and blood forming organs (29 items, 5.36%).<br>Systemic hormonal preparations, sex hormones and insulin's (27 items, 4.99%).<br>Anti-parasitic products, insecticides and repellents (25 items, 4.62%).<br>Genitourinary system (20 items, 3.69%).<br>Antineoplastic and immune-modulating agents (3 items, 0.55%).<br>Various others (26 items, 4.80%). | | |
| 2012 | Ibrahim *et al*. | Egypt; Alexandria | Cardiovascular system drugs were the most common pharmacological group of returned medications. The returned medications were classified according to the British National Formulary (BNF).<br>Cardiovascular system (127 items, 19.4%).<br>Anti-infective (126 items, 19.2%).<br>Gastrointestinal system (66 items, 10.9%).<br>Nutrition and Blood (69 items, 10.6%).<br>Non-steroidal anti-inflammatory (64 items, 9.8%).<br>Nervous system (61 items, 9.3%). | Not studied. | This study did not estimated the quantities of unused medicines in patient's home. As result, it is likely that it may underestimated the extent of unused medicines in the community. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Respiratory system (58 items, 8.9%).<br>Endocrine system (49 items, 7.5%).<br>Skin care (19 items, 2.9%).<br>Ear-Nose-Throat (7 items, 1.1%) and Genitourinary system (7 items, 1.1%).<br>Musculo-skeletal system (2 items, 0.3%). | | |
| 2010 | Guirguis et al. | Australia; St Vincent's Hospital, Melbourne | Cardiovascular system drugs were the most common pharmacological group of returned medications. The smallest group was that of topicals, e.g. creams and ointments.<br>Cardiovascular system drugs (78 items, 26.6%).<br>Analgesics/anti-inflammatories (62 items, 21.2%).<br>Neuropsychiatry drugs (8.5%).<br>Respiratory system drugs (8%).<br>Eye/Ear/Nose drugs (7.5%).<br>Gastrointestinal drugs (7%), and Antimicrobials (7%).<br>Herbals and vitamins (12 items, 4.1%).<br>Diabetes drugs (3%).<br>Topicals, e.g. creams and ointments (8 items, 2.7%)<br>Miscellaneous (4.5%). | They report that they collect topicals cream, ointment along with other dosage forms (that was not defined). | Sample size and the number of return is small which make it difficult to extrapolate the result to whole Australia. |
| 2014 | Kagashe *et al*. | Tanzania; tertiary | Medicines wasted in this study were categorized into three major groups, | Oral solids drugs were the most common wasted dosage | Because only hospital prescribed medicines was included, others |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | hospital in Dar es Salaam city | anti-infective, cardiovascular medications and others.<br>Anti-infective drugs 18.9%.<br>Cardiovascular drugs 8.9%.<br>Other drugs 23.7%. | form 40.6% followed by injections 9.2%, with very few topicals preparations. | maybe missed which may underestimated the extent of unused medicines. |
| 2007 | Abahus sain *et al*. | Kuwait; Kuwait city | No medicines were collected from the 200 households participating in the municipal collection program The second intervention yielded 123 medicines from 14 homes, the most common class of unwanted medicines were drugs for respiratory system. Unwanted medications were classified according to the ATC WHO classification.<br>A third of all unwanted medicines were for the respiratory system (38% of these were cough and cold preparations, 25% nasal preparations). 12% of the medicines were for the musculoskeletal system (53% oral NSAIDs) or were dermatologicals (33% topical antibiotics) | There were 141 items (including duplicates). 508 tablets/capsules, 25 oral liquids, 20 tubes, 21 dropper bottles and various other dosage forms. | Sample size and the number of return is small which make it difficult to extrapolate the result to whole Kuwait.<br><br>Unable to describe respondent demographic information. |
| 2013 | Aditya S | India; dental hospital in North India. | Qualitative analysis of expired medications at home revealed antipyretics (54%), analgesics (64%), followed by antihistamines (35%) to be hoarded in home pharmacies/medicine | Not studied | Small sample size from specific region in India, which make it difficult to generalise and extrapolate the results to whole India. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | chests. Other drugs were antibiotics (26%), antacids (23%), topical drugs (39%) and supplements (vitamins) (41%)<br>Excessive buying of over-the counter (OTC) drugs<br>(53%); self-discontinuation (17%), and expiration of drugs (24%) resulted in possession of unused/leftover medications at home. | | |
| 2011 | Gupta *et al.* | India; Greater Noida City | Most of the expired drugs are in the category of analgesics and NSAID's (23.93%) followed by nutritional supplements (22.56%), antibiotics (14.94%), expectorants and mucolytics (6.77%), bronchodilators (5.31%) and antacids (6.53%). | Oral tablets were the most common, other dosage forms include syrups, capsules, suspensions, powders, eye drops, gels, churna, cream, and ear wax softener. | Defined medicine wastes as only expired medicines which may underestimated the extent of unused wasted medicines. |
| 2009 | Ali *et al.* | Malaysia; Universiti Sains | The total number of medicines found unused was 1724 drug products with vitamins and minerals as the most common class of unused drugs.<br>Vitamins & minerals 427 (24.8%)<br>Gastrointestinal drugs 298 (17.3%)<br>Analgesic & antipyretics 293 (17.0%)<br>Antibiotics 174 (10.0%)<br>Ear, nose & throat drugs 159 (9.2%)<br>Respiratory drugs 106 (6.3%)<br>Dermatological products 97 (5.6%) | 68.5% (n=1181) of the medications were in the form of tablets and pills while capsules constituted 14.6% (n=252) of the overall amount. 5% (n=87) syrups and suspensions while 4.9% (n=84) were creams and ointments.<br>Less than 1.0% (n=5) consisted of inhalers, with | Sampling of only female students made it impossible to generalize the results to the whole student population in the campus. |

| Year of study | Author (s) | Settings/ Country | Therapeutic category of the unused wasted medicine | Dosage form | Study limitation |
|---|---|---|---|---|---|
| | | | Anti-rheumatic & anti-inflammatory 69 (4.0%)<br>Others (CNS drugs, endocrine & metabolic drugs, cardiovascular drugs, genitourinary drugs, and others 101 (5.8%) | 0.2% (n=4) suppositories of the overall total. | |
| 2014 | Aboagye *et al*. | Ghana | Leftover medicines:<br>Paracetamol tablets 27<br>Amoxicillin capsules 12<br>Aspirin tablets 4<br>Metronidazole tablets 5<br>F-PAC (Paracetamol/Aspirin/Caffeine) 3<br>Vitamin B Complex tablets 7<br>Multi-vitamins tablets 7<br>Diclofenac tablets 3<br>Magnesium Trisillicate tablets 3<br>Ibuprofen tablets 5<br>Others/Unidentified 45<br>Do not remember 1 | Not studied | Sample size and the number of return is small which make it difficult to extrapolate the result to whole Ghana.<br><br>Leftover medicines were described as individual medicine not as a group. |

## Appendix 3 University of Reading Research Ethics Committee approving ethical application through the school exemption process (copy of the email approval)

Dear Parastou,

I am pleased to say that Prof Osborn has approved your application for ethical approval via the in-School exceptions route. This email constitutes your permission to proceed with the studies as described in your application.

The following study number has been assigned to your study and you should quote this number in any correspondence you undertake about your studies.

**30/15 Public perceptions about medication reuse: to explore public perceptions and attitudes towards medication reuse**

If you feel that you need to make changes to the way your studies are run, please let us know at the earliest opportunity and we can advise you of whether a formal amendment to your proposal is required or not.

I wish you the best of luck with the projects and finish by reminding you of the need for safe custody of project data at all times (a service that Cat Hale can provide if you require it)

Best wishes

Julie

## Appendix 4 Participant information letter about the elicitation study

*PhD Pharmacy Student*
Mr. Hamza Alhamad
**h.q.m.alhamad@pgr.reading.ac.uk**

*Director, Pharmacy Practice*
Dr Parastou Donyai
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**Letter of information for consent to participate in the interviews**

**Title of Study: Public perceptions about medication reuse: to explore public perceptions and attitudes towards medication reuse**

**Invitation**

I would like to invite you to take part in a research study. Before you decide I would like you to understand why the research is being carried out and what it would involve. If you need any clarification after reading this information sheet, I can arrange to meet and go through the information sheet with you in order to answer any questions you have – please see the top of this information sheet for my contact details. I believe that reading this information sheet should take about 5 to 10 minutes of your time.

*Part 1* tells you the purpose of this study and what will happen to you if you take part.

*Part 2* gives you more detailed information about the conduct of the study.

Please contact me if there is anything that is not clear.

## Part 1

### What is the purpose of the study?

The purpose of this study is to find out patients' and the public's view on medication waste, and their thoughts on potentially reusing any returned, unwanted and unused medication.

The aim is to examine reasons that might lead to medication waste and thoughts on reusing someone else's returned medicines. This research will form the basis of my PhD (Mr. Hamza Alhamad). I am studying under the supervision of Dr Parastou Donyai at the School of Pharmacy, University of Reading.

### Why have you been invited?

You are being invited because we would like patients' and the public's perspective on medication waste and the idea of reusing returned unwanted and unused medication. You are invited as you match the study selection criteria: a member of the public who is more than 18 years old, who has any chronic condition (disease), is currently taking one or more prescribed medication, and has been taking medication for their chronic condition for at least 12 months.

### Do you have to take part?

It is up to you to decide to join the study. The participation is voluntary. I can arrange to meet with you in order to describe the study further and go through this information sheet if

necessary. If you agree to take part, I will then ask you to sign a consent form before I interview you. You are free to withdraw at any time, without giving a reason. A copy of this information sheet and a signed consent form will be given to you to keep.

**What will happen to you if you take part?**

The consent form and information sheet will be given to you before the interview to re-read and then sign two copies for each of us to keep a copy. If you agree to take part in the study, we will arrange a suitable time for you to come to the University of Reading to speak with me in a 30-45-minute interview. The interview could potentially last an hour, depending on the question and answer responses but the average interview time we expect would be 30-45 minutes. With your permission, the interview will be audio-recorded to make sure I obtain all the information accurately. The information provided and recorded will be kept securely.

**Expenses and payments**

A £10 Amazon voucher will be emailed to you after the interview to thank you for taking part.

**What will you have to do?**

If you are interested in participating in this study, please contact me by e-mail (h.q.m.alhamad@pgr.reading.ac.uk). I will then contact you in order to invite you to the University of Reading, so we can meet and arrange a time and date convenient to you. I will bring with me a list of pre-arranged questions to discuss, but we will also have the flexibility to talk about other issues which you find important in this area. As I mentioned

above, although expected to last 30-45 minutes, the interview may take up to a maximum of an hour, depending on our discussions. The questions will be about your opinions and experiences relating to medicines waste and the thought of reusing returned medication.

**What are the possible disadvantages and risks of taking part?**

This study should not pose any risks. During the interview, you have a right to not answer any questions that you feel uncomfortable with and can stop the interview at any time. If you feel you need a break within the interview, let me know and we can take a break. The contact details of my supervisor are provided at the top of this sheet and they will be able to talk to you if you require additional support.

**What are the possible benefits of taking part?**

I cannot promise the study will help you in any specific way but you may find participating and reflecting on the topic helpful personally and of course the information we get from this study may help gain an understanding of views on this current topic, and could help reduce medication waste in the future.

**What if there is a problem?**

Further information on this is given in Part2.

**Will my taking part in the study be kept confidential?**

Yes. We will follow ethical and legal practice and all information about you will be handled in confidence. The details are included in Part 2.

**If the information in Part 1 has interested you and you are considering participating, please read the additional information in Part 2 before making any decision.**

## Part 2

**What will happen if you don't carry on with the study?**

If you do not wish to carry on with this study, for example you wish to pull out of the interview having arranged it in advance, you can withdraw at any time without giving a reason.

**What if there is a problem?**

If you have any complaints about the way you have been dealt with during the study, this can be addressed by contacting my research supervisor. For contact details, please see the header of this Information Sheet.

**Will my taking part in the study be kept confidential?**

Confidentiality will be ensured for all participants, and all data collected from the interviews will be used only for scientific research purposes. Interviews will be recorded with your permission using a digital audio-recorder. All recordings made will be removed from the audio-recorder and transferred to a secure memory stick as soon as possible. This memory stick will then be stored in a locked in a cupboard in a secure office and accessible only to the PhD student (Hamza Alhamad), and PhD supervisor Dr. Parastou Donyai. The recordings will then be transcribed into a word document by '' "The Transcription Agency" which is an approved University of Reading supplier for transcribing services and

names or any other details that might identify the participant will be removed from the transcripts. All information will be anonymised using a number to prevent association of participants to defined quotations – non-identifiable codes will be used and other identifiable information will be altered. This is critical to ensure your anonymity and confidentiality throughout the write up of the results. During the study the memory stick and the transcript as word documents will be stored safely and will be accessible only by the researcher and the supervisor. The information will not be saved on public or personal computers. If requested, you will be given the access to the transcript of your own interview, and you will have the opportunity to review this before it is finalised and used in the research. At the conclusion of the study the digital recordings will be deleted. None of the information that you provide will be disclosed to a third party.

**What will happen to the result of the study?**

The results of the study will be used in my PhD thesis. The outcomes may be presented at academic and professional conferences and in academic journals. The detail of all participants will be kept confidential and you will not be identifiable from any research paper or other publications. The data collected from your interview will be destroyed when the research is completed.

**Who is organising and funding the research?**

This study is being conducted with the University of Reading acting as the academic institution for my PhD. In addition, my research is supported by a full-time scholarship provided by ALZARQA University in Jordan.

**Who has reviewed the study?**

This study has been reviewed and approved by the University of Reading Research Ethics Committee procedures.

**Thank you for taking the time to read about my research.**

PhD Pharmacy Student, Mr. Hamza Alhamad, h.q.m.alhamad@pgr.reading.ac.uk

## Appendix 5 Participant consent form

*PhD Pharmacy Student*
Mr. Hamza Alhamad
**h.q.m.alhamad@pgr.reading.ac.uk**

*Director, Pharmacy Practice*
Dr Parastou Donyai
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UK
*Email*:
**h.q.m.alhamad@pgr.reading.ac.uk**

**Title of Study: Public perceptions about medication reuse: to explore public perceptions and attitudes towards medication reuse**

**Name of Researcher: Hamza Alhamad**

I have read and had explained to me by the researcher the accompanying Information Sheet relating to the project entitled above I have had explained to me the purposes of the project and what will be required of me, and any questions I had, have been answered to my satisfaction. I agree to the arrangements described in the Information Sheet in so far as they relate to my participation.

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ( ).

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason ( ).

3. I understand that while most interviewees will find the discussion interesting and thought-provoking, if nonetheless I feel uncomfortable in any way during the interview

session, I have the right to decline to answer any question or to end the interview ( ).

4. I understand that my participation in this study involves being interviewed by researcher from University of Reading and the interview will last approximately 30-45 minutes and will be audio-recorded. I give my permission to the researcher to audio-record the interview by using a digital voice recorder ( ).

5. This project has been subject to ethical review, according to the procedures specified by the University Research Ethics Committee, and has been given a favourable ethical opinion for conduct ( ).

6. I understand that my confidentiality as a participant in this study will remain secure and that the transcript of my interview will not contain my name ( ).

7. I have been given a copy of this consent form and the accompanying information letter ( ).

8. I wish to receive a summary of the results once the study is complete and analysed scientifically. For that to take place (receiving a summary of the results), I give my contact details below ( ):

……

……

……

9. I agree to take part in the above study

Name……

Signed…….

Date……..

Witnessed by

Name……..

Signature……

Date……

**Appendix 6 Copy of an advert used for the recruitment of participants in the elicitation study**

# Could medicines be reused?

Do you currently use, or have you in the past used, medicines on a regular basis for an ongoing illness (for example, asthma, blood pressure, diabetes)? If so, are you willing to speak to a researcher, at the University of Reading's School of Pharmacy, about your views on the reuse of medicines?

Medicine reuse is the idea that medicines returned by one patient can be dispensed by a pharmacist to another patient (instead of disposal as waste – which is what currently takes place).

Your views are important to this study. If you would be willing to be interviewed on this subject at our Whiteknights campus, we can reimburse you for reasonable travel expenses and offer you a £10 Amazon voucher for your time.

Please contact:
**Hamza Alhamad**
**h.q.m.alhamad@pgr.reading.ac.uk**

# Is cocoa good for brain function?

At the University of Reading we are looking for healthy non-smokers aged 60–75 years who would like to take part in a study investigating the long-term effects of a cocoa-based supplement on cognitive performance and the brain.

The study is taking place over 36 weeks during which you would be required to consume a cocoa-based supplement or placebo daily for 24 weeks. However, you will only need to attend the University on three mornings to provide a blood sample, complete some questionnaires and computer-based tasks, and undergo ultrasound of an artery in your upper arm as well as brain imaging. You'll need to arrive fasted but food will be provided during the visit. In addition, you will be asked to bring a 24-hour urine sample with you.

We would be very grateful for your assistance and you will be compensated for your time and travel expenses

Eligibility to participate would be determined following a screening visit, but if you are generally healthy and do not take medication for blood pressure or diabetes, we would love to hear from you.

Please contact Anja or Georgina from the

## Appendix 7 Interview schedule used in the elicitation study

From the email you sent, you indicated your interest in the concept of medicines reuse. Please outline any experience of unused medicine (for example, which you might have returned back to the pharmacy. Would you please tell me more about unused medicines returned back to a pharmacy? What do you imagine the pharmacist does with these returned medicine?)

Please take a few minutes to tell us what you think about the possibility of people reusing returned medicines in the UK.

There are no right or wrong responses; we are merely interested in your personal opinions. In response to the questions below, please tell us the thoughts that come to mind.

What do you see as the advantages of medicines reuse?

What do you see as the disadvantages of medicines reuse?

What else comes to mind when you think about medicines reuse?

Would you agree to accept medicines for yourself that have been returned to a pharmacy by others?

When it comes to you reusing medicines, there might be individuals or groups who would think you should or should not perform this behaviour.

Which individuals or groups would approve or think you should reuse medicines?

Please list the individuals or groups who would disapprove or think you should not reuse medicines.

Sometimes, when we are not sure what to do, we look to see what others are doing. Please list the individuals or groups who are likely to reuse medicines?

Please list the individuals or groups who are least likely to reuse medicines?

Please list any factors or circumstances that would make it easy or enable you to reuse medicines

Please list any factors or circumstances that would make it difficult or prevent you from reusing medicines

Thank you very much for your valuable time and information.

Project debrief.

## Appendix 8 Summary of thematic coding and analysis

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| Medicine reuse should be regulated and monitored by NHS to avoid the risk of having black market, this include pharmacist selling the collected medicines online, and also counterfeit medicines that patient bought online should not put back the shelf (if returned) and this will be assured during a quality check by the pharmacist. (P17, female, >70 age group) | - Medicine reuse process<br>- Medicine reuse process risks<br>- Medicine bought online<br>- black market<br>**1.** and counterfeit medicines | Medicine reuse process:<br>*Regulation of medicine reuse process*<br>*Risks associated with medicine reuse process e.g.*<br>*Black market and counterfeit medicines* | Medicine reuse to be regulated by NHS. |
| I think the majority of people because of the trust they have in the health service, if it was standard practice for the health service then they may well accept it. The difficulty would be if you made it look as though it was a practice carried out by pharmacists, they might object. It would have to be seen to be something that's done by the health service, OK, rather than by the pharmacy, the pharmacy only acting as an agent for the health service. (P15, male, 50-59 age group) | - Trust in in the services provided by NHS<br>- If it is run as pharmacy service it should be under control by NHS | NHS should the regularity body for medicine reuse process.<br>*Medicine reuse should not be just regulated by pharmacy service alone without NHS control* | Trust in the NHS services |
| Mainly I would say economy, because it does seem wasteful that these things cost a lot of money to research and develop and produce, then package and transport, then being wasted, so it is a question of economy. (P2, male, >70 age group) | - Medicine reuse is economic solution for medicinal waste | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Medicine reuse economic advantage<br>Saving money for NHS |
| I would say the main advantage of reusing medicines is saving on cost, in this country masses of drugs are wasted. When you have been prescribed something and did not need much of it, and then you think what an awful waste? Surely it would be better to return it and somebody else able to use it. (P5, Male, 60-69 age group) | - A lot of medicine is wasted reusing medicines could save NHS money | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Medicine reuse economic advantage<br>Saving money for NHS |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| I think medicine reuse would be an efficient thing to do financially and environmentally, because if you are reusing you are not having to produce as much, and also you are reducing waste. (P7, female, 60-69 age group) | - Medicine reuse has financial and environmental advantages | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Economic and environmental advantages of reusing medicines |
| Generic medicines, maybe they are so cheap that a packet of aspirin cost maybe 16p or something, but maybe some of the more expensive medicines that is definitely worth reusing. (P3, male, 40-49 age group) | - Medicine costs (cheap vs. expensive medicines) | Medicine reuse is mainly applicable for expensive medicines<br>*Medicine reuse is financial solution of medicine waste especially for expensive medicines* | Medicine costs (expensive vs. cheap medicines) worth reusing |
| Most people just dispose of their medicines in the bin, and probably only a minority of people actually take the medicines back to the pharmacy. A lot of these medicines contain chemicals which probably make their way into the water and could pollute water supply. Oestrogen for example could make its way into the water supply. I don't know whether these chemicals break down within a period of time and become inert, or whether they continue to be active and modify the environment. (P3, male, 40-49 age group) | - Medicines reuse reduce the proportion of medicines thrown into household bins.<br>- Medicines reuse encourage people to return their unused medicines to the pharmacy<br>- Medicines reuse decrease environmental pollution caused by medicinal waste | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Environmental advantage of medicine reuse |
| I do believe there's an enormous amount of medicine wasted, and sometimes I wonder what happens to these wasted medicines as it would be awful to wash it down the water works, all these drugs and chemicals would harm health in another sort of way. And I | - Medicines are wasted in large amount | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Environmental advantage of medicine reuse |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| have always wondered why if they're intact they're not reused (P11, female, 40-49 age group) | - Negative environmental effect of medicinal waste | | |
| People Flush medicines down the loo or just put it in the rubbish bin. Dreadful. When Hormones such as oral contraceptives flushed down the loo, it was linked to low sperm count in men (P16, female, 40-49 age group). | - Flushing hormones into the water system has a negative impact in men's health | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Environmental advantage of medicine reuse |
| I think one of the reasons people put medicines down the loo is because they know if they take the medicine back to the pharmacist he is going to destroy them anyway so they think, why I should make the effort with this, pointless. They don't understand the damage they might be doing so I think there would be an environmental benefit. (P15, male, 50-59 age group) | - Perception of people about the reason on slushing medicines down the low<br>- Pharmacy will destroy the returned medicines , so no need to return them | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Environmental advantage of medicine reuse |
| So what I'm describing I think are people who are more aware, shall I say, of a bigger picture, they're not thinking just personally, they're thinking what can I do, does it save the environment, if one less packet of pills has to be made that's one less energy, that's less transport, it's all the good reasons, not just money. (P2, male, >70) | - Unused medicinal waste impact on the environment (carbon footprint) | Consequences of medicines reuse<br>*Potential advantages of medicines reuse* | Environmental advantage of medicine reuse |
| I think my concerns about medicine reuse would be the hygiene aspects of the returned medicine as I want to know if it was stored in a clean place, and that I wasn't going to get any kind of infection or problem with it. (P1, female, 60-69 age group) | - concerns about reusing medicines<br>- Medicines storage?<br>- Risk of infection? | Consequences of medicines reuse<br>*Potential disadvantages of medicines reuse* | Medicine reuse risks e.g. infection transmission |
| I think the main issue of reusing medicines would be the risk. I suppose some medications have to be stored at certain temperatures, | - concerns about reusing medicines | Consequences of medicines reuse | Reuse applicability for medicines |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| like insulin. Also you would have to be assured that the medicine had not been tampered with. (P4, female, 60-69 age group) | - Medicines require certain storage temperature. | *Potential disadvantages of medicines reuse* | required certain temperature |
| The thing that would concern me about reusing medicines is if the drugs had become contaminated somehow, so there would have to be a very thorough check to make sure something has not been contaminated in some way. (P5, male, 60-69 age group) | | Consequences of medicines reuse<br>*Potential disadvantages of medicines reuse* | Medicine reuse risks e.g. medicines being contaminated |
| There could be a risk of medication error being made, for example if somebody put a medication back in the wrong box and returned it. There have to be very strict rules on checking the returned medicines. (P6, male, >70 age group) | Medicine reuse can be associated with medication error | Consequences of medicines reuse<br>*Potential disadvantages of medicines reuse* | Medicine reuse risks e.g. medication error |
| I suppose there is a slight risk of a wrong drug getting into a wrong packet or being placed in the wrong place somewhere, so being mis-prescribed but I think it is quite small because pharmacists are so careful when the check what they give you. (P17, female, >70 age group) | Medicine reuse can be associated with medication error | Consequences of medicines reuse<br>*Potential disadvantages of medicines reuse* | Medicine reuse risks e.g. medication error |
| I'm a dyed in the wool Conservative, but I think the Green Party for example would be positive about medicine reuse and may campaign for it." (P2, male, >70 age group) | - Green party will support medicine reuse | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might approve of medicine reuse* | The green movement |
| I think people part of the Green movement will approve medicine reuse. (P3, male, 40-49 age group) | - People who thinks green will support medicine reuse<br>- Green party will support medicine reuse | Exemplar and anti-exemplar individuals and groups | The green movement |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| | | *Individuals or group of people who might approve of medicine reuse* | |
| I think my husband and some friends, I think people who thinks green would support it. I would have thought most environmentalists would support it because the other things is, a lot of this stuff does end up in the water somehow or other, and affects wildlife. (P17, female, >70 age group) | - Friends, spouses and partners, families and people who thinks green will support medicine reuse | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might approve of medicine reuse* | Friends, families and people who thinks green |
| I think older people, the make do and mend generation who experienced shortages after Second World War, who are fast becoming rare and rarer (P14, male, 60-69 age group) | - Elderly people may like the idea of reusing medicines | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might approve of medicine reuse* | Elderly people may like the idea of reusing medicines |
| I think particularly amongst the older generation would probably be more susceptible to saying, yeah medicine reuse is good idea, because we were brought up not to waste things. I do not know if youngsters think about that kind of thing as much because there is a surplus of everything these days but there was not when we grew up so we don't, we still don't waste things, we still mend things. (P17, female, >70 age group) | - Elderly people may like the idea of reusing medicines | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might approve of medicine reuse* | Elderly people may like the idea of reusing medicines |
| I think drug manufacturers may think that medicine reuse is a bad idea, because they are making an absolute fortune out of the NHS. (P6, male, >70 age group) | - Pharmaceutical companies may not like the idea of reusing medicines.<br>- Medicine reuse can be against pharmaceutical company profit | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might **not** approve of medicine reuse* | Pharmaceutical companies profit vs. medicine reuse |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| I wonder if people working in pharmaceuticals would not frown upon it in some way if their profits are being affected. (P11, female, 40-49 age group) | - Medicine reuse can be against pharmaceutical company profit | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might **not** approve of medicine reuse* | Pharmaceutical companies profit vs. medicine reuse |
| I'm very suspicious of the pharmaceutical companies as they like to produce more drugs and they make more money, so really I'm very suspicious because they are enormous conglomerates. It's to their benefit because they make a lot of money, absolutely. (P18, male, >70 age group) | - Pharmaceutical company like to produce more drugs and more money<br>- Medicine reuse can be against pharmaceutical company profit | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might **not** approve of medicine reuse* | Pharmaceutical companies profit vs. medicine reuse |
| Getting access to the NHS services is at the cost of the UK taxpayer. I think because it's so ingrained in this country, the NHS and the prescription process, that people almost feel that it is now like an entitlement to have the genuine medicine at a fixed cost, and that kind of thing. (P1, female, 60-69 age group) | - Taxpayer may think they are entitled to have brand new medicine as they pay taxes and may not like the idea of medicine reuse | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might **not** approve of medicine reuse* | Taxpayer may not like medicine reuse |
| I think mothers are probably very cautious for their offspring, and wants the best for her child, there's a kind of feeling because it's brand new, off the shelf, it's purer, it's safer, there's no element of risk. (P2, male, >70 age group) | - Mother may not approve reusing medicines for their children<br>- Safety issues | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might **not** approve of medicine reuse* | Mother may not approve medicine reuse |
| I think people might be resistant for example with drugs that are for babies. I think that might be seen as a very special group. (Participant 7, female, 60-69 age group) | - Medicine should not be reused for babies | Exemplar and anti-exemplar individuals and groups | babies is a special group of people where medicine |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| | | *Individuals or group of people who might **not** approve of medicine reuse* | should not be reused for babies |
| Elderly people, I think might think that you shouldn't do that when it comes to elderly people, people with maybe cancer, and these kind of very serious disease." (P7, female, 60-69 age group) | - Medicine should not be reused for Elderly | Exemplar and anti-exemplar individuals and groups<br>*Individuals or group of people who might **not** approve of medicine reuse* | Elderly may have serious disease such as cancer and may require brand new medicines |
| I don't think medicine in a liquid form can be reused, someone might introduce something such as foreign body. This apply to gel and cream which is maybe easier to inject or get something in it, whereas in a blister pack you can tell whether it is been tampered with or not. (P7, female, 60-69 age group) | - Liquid medicines dosage forms should not be reused<br>- Blister pack medicines can be reused | Expectations about returned medicines<br>*Physical characteristics of returned medicines* | Medicines dosage forms vs. medicine reuse |
| If the returned medicine has only six months life left then it may not be put back on the shelf to give it to some people. (P9, female, >70 age group) | - Medicines should have more than six months of shelf life to be reused | Expectations about returned medicines<br>*Physical characteristics of returned medicines* | Medicine shelf life vs. medicine reuse |
| I can understand why opened packets have to be destroyed, as there is too high a risk of being tampered with. But there should be a way of reusing those unopened medicines, and those still within date, I do not know what would need to be put in place, but it just seems wrong to bin them. (P10, male, 60-69 age group) | - Opened medicines should not be reused<br>- Blister pack medicines can be reused | Expectations about returned medicines<br>*Physical characteristics of returned medicines* | Medicine shelf life can't be reused as there is a risk to be tampered with |
| I would be quite happy to reuse medicines as long as I know that the safeguards have been put in place that the returned medicines has not been tampered with. (P4, female, 60-69 age group) | - Medicines that can be reused should be quality checked and should not be tampered with. | Expectations about returned medicines<br>*The quality assurance of returned medicines* | Medicine quality should be checked before |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
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| | | | redistributing medicines |
| I think another key thing is temperature control, I think most people would have a medicine cabinet in the bathroom, and that always amuses me because you have got the humidity and the heat of showers and baths. So I think whenever people buy medicine cabinets there should be an instruction saying don't use them in a bathroom." (P5, Male, 60-69 age group) | - Quality of the returned medicines, storage conditions, temperatures | Expectations about returned medicines *The quality assurance of returned medicines* | Quality of the returned medicines vs. medicine reuse |
| So all returned medicine have to be checked, I suppose there is a slight risk of having counterfeit medicines from untrusted sources include those bought online getting into pharmacy shelf. (P17, female, >70 age group) | - Returned medicines should be quality cheeked before being redistributed<br>- Counterfeit medicines should not be allowed for reuse | Expectations about returned medicines *The quality assurance of returned medicines* | Returned medicines should be quality cheeked before being redistributed and medicines from untrusted sources should not be reused |
| As all returned medicine have to be checked. So this could be a disadvantage in terms of pharmacists' time because they are very busy in chemists, aren't they? Very busy pharmacists. (P17, female, >70 age group) | - Does the pharmacist time to check the returned medicine<br>- | Expectations about returned medicines *The logistics of medicine reuse* | pharmacist time a vs. medicine reuse |
| Pharmacist may not have the room to put back medicines into the shelf , I am thinking of our pharmacy, it is small, and maybe there is no enough space in the pharmacy for the returned medicines. (P6, male, >70 age group) | - Is there any space in the pharmacy to put back the returned medicines into the shelf | Expectations about returned medicines *The logistics of medicine reuse* | space in the pharmacy vs. medicine reuse |
| I think the pharmaceutical companies will have to collaborate to help in medicine reuse process, I know this is terrible thing, because they're all in competition, but it would be good if they | - Pharmaceutical company collaboration | Expectations about returned medicines | Pharmaceutical company collaboration in |

| Participant responses (the final quoted ones) | Final coding | Major theme/*minor theme* | sub- theme |
|---|---|---|---|
| could have some way of collaborating whereby the pooled, they all put money into these centres to fund it as almost like a, not exactly a charity, but like a community investment type idea. (P7, female, 60-69 age group) | in medicine reuse process | *The logistics of medicine reuse* | medicine reuse process |
| Medicines have labels on them, so one assumes that if you gave them back to the pharmacy, for example, he would then have to send them back to the supplier, the supplier would have to send them back to the manufacturer, the manufacturer would then have to repackage them, and then they have to come all the way back down the chain. (P12, female, 60-69 age group) | - Medicines may need repackaging and or relabelling before being reused | Expectations about returned medicines<br>*The logistics of medicine reuse* | Can the unused medicines send back to the manufactures for repackaging and relabelling |
| I would have a knowledge of my pharmacist because I go to the same place and they know what medication I'm on and if somebody has changed their medication or whatever and so returns some tablets and the pharmacist know that I take those. So pharmacist can probably say here we are Mr. X, here is those returned tablet and they are 50 pence instead of £1 or whatever it is. So that sort of thing. (P14, male, 60-69 age group) | - Incentives were thought to encourage patients to return unused medicines instead of unsafe disposal practices<br>- Incentives could be a point-based rewards systems | Expectations about returned medicines<br>*The logistics of medicine reuse* | Incentives and rewards may encourage medicine reuse. |

## Appendix 9 First draft (v1) of Medicine Reuse Questionnaire (MRQ)

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| 1. Reusing medication in the future is *Harmful 1 2 3 4 5 6 7 beneficial* |
| 2. Reusing medication in the future is *good 1 2 3 4 5 6 7 bad* |
| 3. Reusing medication in the future is *satisfying (for me) 1 2 3 4 5 6 7 dissatisfying (for me)* |
| 4. Reusing medication in the future is *worthless 1 2 3 4 5 6 7 worthwhile* |
| 5. I would feel under social pressure to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 6. Most people who are important to me would want me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 7. It would be expected of me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 8. Most people who are important to me would think that ---------- reuse medication in the future *I should 1 2 3 4 5 6 7 I should not* |
| 9. I expect to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 10. I want to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 11. I intend to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 12. I am confident that I could reuse medication in the future if I wanted to *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 13. For me to reuse medication in the future is *possible 1 2 3 4 5 6 7 impossible* |
| 14. The decision to reuse medication in the future is beyond my control *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 15. Whether I reuse medication or not in the future is entirely up to me *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 16. I think for me to contribute toward reducing the harmful effects of medication on the environment is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 17. I think for me to contribute toward reducing the NHS drug expenditure is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 18. . I think for me to receive low quality medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 19. I think for me to receive unsafe medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 20. I think for me to receive incorrect medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 21. Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 22. Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 23. . Reusing sealed, returned blister-pack medication will result in me receiving low quality medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |

| |
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| 24. Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 25. Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 26. Environmentalists would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 27. The pharmaceutical industry would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 28. My close friends would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 29. My family would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 30. Generally speaking, how much do you want to do what environmentalists believe you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 31. Generally speaking, how much do you want to do what pharmaceutical industry believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 32. Generally speaking, how much do you want to do what close friends believe you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 33. Generally speaking, how much do you want to do what your family believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 34. I expect that any medication offered to me for reuse will be in the original, sealed, blister-packaging *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 35. I expect to see evidence that any medication offered to me for reuse would have been quality-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 36. I expect to see evidence that any medication offered to me for reuse would have been safety-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 37. I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 38. I expect to be offered some form of reward for reusing medication *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 39. It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister-packaging *strongly disagree -3 -2 -1 0 1 2 3 strongly agree* |

40. It would make it easier for me to reuse medication if I could see that it had been quality-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

41. It would make it easier for me to reuse medication if I could see that it had been safety-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

42. It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

43. It would make it easier for me to reuse medication if I were offered some form of reward *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

44. Are you currently taking medication for a long term condition?
a) Yes
b) No

45. Choose one option that best describes your age range?
a) 25 or under
b) 26-40
c) 41-55
d) 56 or older
e) I prefer not to say

46. What is your gender?
a) Male
b) Female
c) Other (please specify here)
d) I prefer not to say

47. What is your religion?
a) No religion
b) Christian (including Church of England, Catholic, Protestant and all other Christian denominations)
c) Muslim
d) Jewish
e) Buddhist
f) Hindu
g) Sikh
h) Other

i) I prefer not to say

48. Choose one option that best describes your ethnicity?

a) White (English / Welsh / Scottish / Northern Irish/British)
b) White (Irish)
c) White (Gypsy or Irish traveller)
d) Any other White background, please describe below
e) Mixed / Multiple ethnic groups (White and Black Caribbean)
f) Mixed / Multiple ethnic groups (White and Black African)
g) Mixed / Multiple ethnic groups (White and Asian)
h) Any other Mixed / Multiple ethnic background, please describe here
i) Asian / Asian British (Indian)
j) Asian / Asian British (Pakistani)
k) Asian / Asian British (Bangladeshi)
l) Asian / Asian British (Chinese)
m) Any other Asian background, please describe here
n) Black / Black British (African)
o) Black / Black British (Caribbean)
p) Any other Black / African / Caribbean background, please describe below
q) Arab
r) Any other ethnic group, please describe here
a) I prefer not to say

49. Choose one option that best describes your highest level of educational achievement?

a) University Higher Degree (e.g. MSc, PhD)
b) First degree level qualification including foundation degrees, graduate membership of a
c) professional Institute, PGCE
d) Diploma in higher education
e) Teaching qualification (excluding PGCE)
f) Nursing or other medical qualification not yet mentioned
g) A Level
h) Welsh Baccalaureate
i) International Baccalaureate

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| j) AS Level<br>k) Higher Grade/Advanced Higher (Scotland)<br>l) Certificate of sixth year studies<br>m) GCSE/O Level<br>n) CSE<br>o) Standard/Ordinary (O) Grade / Lower (Scotland)<br>p) Other school (including school leaving exam certificate or matriculation)<br>q) I prefer not to say<br>a) Other |
| 50. If you have any comments, or ideas regarding the concept of medication reuse, please share them here |

## Appendix 10 SPSS output showing the R matrix (or correlation matrix) produced using Coefficient and Significant levels option

**Correlation Matrix[a]**

| | | BB | BB | BB | BB | BB | NB | NB | NB | NB | CF1 | CF2 | CF3 | CF4 | CF5 | DA1 | DA2 | DA3 | DA4 | DSN1 | DSN2 | DSN3 | DSN4 | DPBC1 | DPBC2 | DPBC3 | DPBC4 | INT1 | INT2 | INT3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlation | BB | 1.000 | .842 | .533 | .682 | .607 | .452 | .135 | .230 | .138 | .374 | .426 | .427 | -.068 | -.290 | .719 | .686 | .477 | .726 | .185 | .664 | .534 | .447 | .475 | .520 | .403 | -.193 | .670 | .763 | .687 |
| | BB | .842 | 1.000 | .533 | .682 | .584 | .514 | .206 | .276 | .220 | .459 | .386 | .400 | .061 | -.217 | .779 | .761 | .495 | .805 | .003 | .578 | .434 | .426 | .558 | .567 | .446 | -.136 | .606 | .757 | .705 |
| | BB | .533 | .533 | 1.000 | .821 | .646 | .340 | .157 | .360 | .239 | .124 | -.016 | .035 | -.195 | -.251 | .529 | .575 | .474 | .540 | .196 | .541 | .365 | .420 | .538 | .486 | .286 | -.024 | .637 | .710 | .705 |
| | BB | .682 | .682 | .821 | 1.000 | .787 | .328 | .032 | .253 | .183 | .275 | .217 | .252 | .013 | -.177 | .738 | .737 | .615 | .712 | .104 | .647 | .441 | .507 | .544 | .515 | .317 | -.019 | .622 | .772 | .702 |
| | BB | .607 | .584 | .646 | .787 | 1.000 | .232 | .005 | .188 | .075 | .315 | .408 | .399 | .136 | .021 | .691 | .678 | .573 | .731 | .046 | .647 | .313 | .489 | .527 | .447 | .307 | -.072 | .557 | .665 | .581 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NB | .452 | .514 | .340 | .328 | .232 | 1.000 | .221 | .384 | .386 | .130 | **.097** | **.067** | .105 | -.077 | **.405** | **.428** | .370 | .370 | .159 | .309 | .296 | .198 | .507 | .220 | .039 | -.070 | .331 | .403 | .433 |
| NB | .135 | .206 | .157 | .032 | .005 | .221 | 1.000 | .361 | .265 | .068 | **.074** | **.091** | -.107 | -.220 | **.161** | **.111** | .157 | .166 | .112 | .178 | .135 | .375 | .226 | .050 | .160 | -.144 | .302 | .236 | .274 |
| NB | .230 | .276 | .360 | .253 | .188 | .384 | .361 | 1.000 | .892 | .119 | **.139** | **.128** | .032 | -.139 | **.189** | **.289** | .301 | .210 | .190 | .412 | .187 | .403 | .439 | .249 | .023 | .124 | .366 | .298 | .405 |
| NB | .138 | .220 | .239 | .183 | .075 | .386 | .265 | .892 | 1.000 | .087 | **.107** | **.085** | .096 | -.111 | **.127** | **.211** | .293 | .144 | .177 | .299 | .117 | .295 | .420 | .199 | -.114 | .168 | .245 | .203 | .272 |
| **CF 1** | .374 | .459 | .124 | .275 | .315 | .130 | .068 | .119 | .087 | 1.000 | **.769** | **.696** | .478 | -.096 | **.381** | **.415** | .204 | .445 | -.250 | .207 | .189 | .144 | .308 | .278 | .316 | .070 | .267 | .297 | .222 |
| **CF 2** | .426 | .386 | -.016 | .217 | .408 | .097 | .074 | .139 | .107 | .769 | **1.000** | **.929** | .443 | .030 | **.475** | **.456** | .266 | .485 | -.172 | .225 | .241 | .209 | .158 | .214 | .223 | .018 | .279 | .244 | .168 |
| **CF 3** | .427 | .400 | .035 | .252 | .399 | .067 | .091 | .128 | .085 | .696 | **.929** | **1.000** | .404 | .047 | **.456** | **.477** | .214 | .507 | -.221 | .215 | .181 | .225 | .097 | .247 | .277 | .090 | .293 | .317 | .237 |

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| **CF4** | -.068 | .061 | -.195 | .013 | .136 | .105 | -.107 | .032 | .096 | .478 | **.443** | **.404** | 1.000 | .336 | **.101** | **.126** | -.143 | .176 | -.457 | -.017 | -.180 | .011 | .064 | -.057 | -.006 | .279 | -.181 | -.119 | -.172 |
| **CF5** | -.290 | -.217 | -.251 | -.177 | .021 | -.077 | -.220 | -.139 | -.111 | -.096 | **.030** | **.047** | .336 | 1.000 | **-.091** | **-.093** | -.190 | -.074 | -.280 | -.243 | -.162 | -.258 | -.267 | -.272 | .126 | .041 | -.319 | -.258 | -.368 |
| **DA1** | .719 | .779 | .529 | .738 | .691 | .405 | .161 | .189 | .127 | .381 | **.475** | **.456** | .101 | -.091 | **1.000** | **.930** | .720 | .920 | .012 | .615 | .507 | .529 | .542 | .648 | .345 | -.102 | .742 | .814 | .724 |
| **DA2** | .686 | .761 | .575 | .737 | .678 | .428 | .111 | .289 | .211 | .415 | **.456** | **.477** | .126 | -.093 | **.930** | **1.000** | .699 | .929 | -.018 | .562 | .542 | .545 | .625 | .706 | .347 | -.010 | .761 | .803 | .782 |
| **DA3** | .477 | .495 | .474 | .615 | .573 | .370 | .157 | .301 | .293 | .204 | **.266** | **.214** | -.143 | -.190 | **.720** | **.699** | 1.000 | .659 | .143 | .547 | .360 | .585 | .533 | .546 | .173 | -.282 | .611 | .712 | .675 |
| **DA4** | .726 | .805 | .540 | .712 | .731 | .370 | .166 | .210 | .144 | .445 | **.485** | **.507** | .176 | -.074 | **.920** | **.929** | .659 | 1.000 | -.033 | .622 | .508 | .561 | .625 | .697 | .444 | -.071 | .693 | .820 | .741 |
| DSN1 | .185 | .003 | .196 | .104 | .046 | .159 | .112 | .190 | .177 | -.250 | **-.172** | **-.221** | -.457 | -.280 | **.012** | **.018** | .143 | -.033 | 1.000 | .256 | .508 | .118 | -.021 | -.023 | .038 | -.318 | .111 | .136 | .159 |

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| DSN2 | .664 | .578 | .541 | .647 | .647 | .309 | .178 | .412 | .299 | .207 | **.225** | **.215** | -.017 | -.243 | **.615** | **.562** | .547 | .622 | .256 | 1.000 | .397 | .734 | .488 | .468 | .295 | -.054 | .633 | .730 | .721 |
| DSN3 | .534 | .434 | .365 | .441 | .313 | .296 | .135 | .187 | .117 | .189 | **.241** | **.181** | -.180 | -.162 | **.507** | **.542** | .360 | .508 | .508 | .397 | 1.000 | .290 | .316 | .415 | .223 | -.189 | .493 | .448 | .468 |
| DSN4 | .447 | .426 | .420 | .507 | .489 | .198 | .375 | .403 | .295 | .144 | **.209** | **.225** | .011 | -.258 | **.529** | **.545** | .585 | .561 | .118 | .734 | .290 | 1.000 | .460 | .542 | .279 | -.117 | .545 | .645 | .634 |
| DPBC1 | .475 | .558 | .538 | .544 | .527 | .507 | .226 | .439 | .420 | .308 | **.158** | **.097** | .064 | -.267 | **.542** | **.625** | .533 | .625 | -.021 | .488 | .316 | .460 | 1.000 | .700 | -.003 | .178 | .623 | .613 | .617 |
| DPBC2 | .520 | .567 | .486 | .515 | .447 | .220 | .050 | .249 | .199 | .278 | **.214** | **.247** | -.057 | -.272 | **.648** | **.706** | .546 | .697 | -.023 | .468 | .415 | .290 | .700 | 1.000 | .215 | .049 | .675 | .730 | .678 |
| DPBC3 | .403 | .446 | .286 | .317 | .307 | .039 | .160 | .023 | -.114 | .316 | **.223** | **.277** | -.006 | .126 | **.345** | **.347** | .173 | .444 | .038 | .295 | .222 | .279 | -.003 | .215 | 1.000 | -.387 | .199 | .418 | .284 |
| DPBC4 | -.193 | -.136 | -.024 | -.019 | .072 | -.070 | -.144 | .124 | .168 | .070 | **.018** | **.090** | .279 | .041 | **-.102** | **-.010** | -.282 | -.071 | -.318 | -.054 | -.189 | -.117 | .178 | .049 | -.387 | 1.000 | -.012 | -.169 | -.061 |

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| | INT1 | .670 | .606 | .637 | .622 | .557 | .331 | .302 | .366 | .245 | .267 | **.279** | **.293** | -.181 | -.319 | **.742** | **.761** | .611 | .693 | .111 | .633 | .493 | .545 | .623 | .675 | .199 | -.012 | 1.000 | .859 | .867 |
| | INT2 | .763 | .757 | .710 | .772 | .665 | .403 | .236 | .298 | .203 | .297 | **.244** | **.317** | -.119 | -.258 | **.814** | **.803** | .712 | .820 | .136 | .730 | .448 | .645 | .613 | .730 | .418 | -.169 | .859 | 1.000 | .903 |
| | INT3 | .687 | .705 | .705 | .702 | .581 | .433 | .274 | .405 | .272 | .222 | **.168** | **.237** | -.172 | -.368 | **.724** | **.782** | .675 | .741 | .159 | .721 | .468 | .634 | .617 | .678 | .284 | -.061 | .867 | .903 | 1.000 |
| Sig. (1-tailed) | BB | | .000 | .000 | .000 | .000 | .001 | .186 | .062 | .180 | .005 | **.002** | **.002** | .326 | .025 | **.000** | **.000** | .000 | .000 | .109 | .000 | .000 | .001 | .000 | .000 | .003 | .100 | .000 | .000 | .000 |
| | BB | .000 | | .000 | .000 | .000 | .000 | .084 | .032 | .071 | .001 | **.004** | **.003** | .344 | .074 | **.000** | **.000** | .000 | .000 | .492 | .000 | .001 | .002 | .000 | .000 | .001 | .184 | .000 | .000 | .000 |
| | BB | .000 | .000 | | .000 | .000 | .010 | .149 | .007 | .055 | .006 | **.057** | **.008** | .097 | .046 | **.000** | **.000** | .000 | .000 | .096 | .000 | .006 | .002 | .000 | .000 | .027 | .438 | .000 | .000 | .000 |
| | BB | .000 | .000 | .000 | | .000 | .013 | .416 | .045 | .111 | .032 | **.074** | **.045** | .067 | .120 | **.000** | **.000** | .000 | .000 | .247 | .000 | .001 | .000 | .000 | .000 | .016 | .449 | .000 | .000 | .000 |
| | BB | .000 | .000 | .000 | .000 | | .060 | .487 | .106 | .310 | .017 | **.002** | **.003** | .184 | .445 | **.000** | **.000** | .000 | .000 | .380 | .000 | .017 | .000 | .000 | .001 | .019 | .318 | .000 | .000 | .000 |
| | NB | .001 | .000 | .010 | .013 | .060 | | .070 | .004 | .004 | .195 | **.060** | **.029** | .243 | .306 | **.003** | **.001** | .006 | .006 | .146 | .018 | .023 | .093 | .000 | .071 | .398 | .321 | .012 | .003 | .001 |

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| NB | .1 | .0 | .1 | .4 | .4 | .0 | | .0 | .0 | .3 | **.3** | **.2** | .2 | .0 | **.1** | **.2** | .1 | .1 | .23 | .11 | .18 | .00 | .065 | .370 | .143 | .170 | .0 | .0 | .0 |
| | 86 | 84 | 49 | 16 | 87 | 70 | | 07 | 37 | 28 | **12** | **74** | 40 | 71 | **42** | **32** | 48 | 35 | 0 | 8 | 6 | 5 | | | | | 21 | 57 | 32 |
| NB | .0 | .0 | .0 | .0 | .1 | .0 | .0 | | .0 | .2 | **.1** | **.1** | .4 | .1 | **.1** | **.0** | .0 | .0 | .10 | .00 | .10 | .00 | .001 | .048 | .440 | .206 | .0 | .0 | .0 |
| | 62 | 32 | 07 | 45 | 06 | 04 | 07 | | 00 | 16 | **78** | **98** | 16 | 78 | **04** | **26** | 21 | 80 | 3 | 2 | 7 | 3 | | | | | 06 | 22 | 03 |
| NB | .1 | .0 | .0 | .1 | .3 | .0 | .0 | .0 | | .2 | **.2** | **.2** | .2 | .2 | **.2** | **.0** | .0 | .1 | .11 | .02 | .21 | .02 | .002 | .092 | .225 | .132 | .0 | .0 | .0 |
| | 80 | 71 | 55 | 11 | 10 | 04 | 37 | 00 | | 82 | **39** | **88** | 64 | 31 | **00** | **80** | 24 | 70 | 9 | 2 | 9 | 3 | | | | | 51 | 88 | 34 |
| **CF 1** | .0 | .0 | .2 | .0 | .0 | .1 | .3 | .2 | .2 | | **.0** | **.0** | .0 | .2 | **.0** | **.0** | .0 | .0 | .04 | .08 | .10 | .17 | .019 | .031 | .016 | .321 | .0 | .0 | .0 |
| | 05 | 01 | 06 | 32 | 17 | 95 | 28 | 16 | 82 | | **00** | **00** | 00 | 62 | **05** | **02** | 87 | 01 | 7 | 3 | 4 | 0 | | | | | 37 | 22 | 69 |
| **CF 2** | .0 | .0 | .4 | .0 | .0 | .2 | .3 | .1 | .2 | .0 | | **.0** | .0 | .4 | **.0** | **.0** | .0 | .0 | .12 | .06 | .05 | .08 | .147 | .076 | .068 | .452 | .0 | .0 | .1 |
| | 02 | 04 | 57 | 74 | 02 | 60 | 12 | 78 | 39 | 00 | | **00** | 01 | 22 | **00** | **01** | 37 | 00 | 6 | 6 | 3 | 2 | | | | | 30 | 51 | 32 |
| **CF 3** | .0 | .0 | .4 | .0 | .0 | .3 | .2 | .1 | .2 | .0 | **.0** | | .0 | .3 | **.0** | **.0** | .0 | .0 | .07 | .07 | .11 | .06 | .260 | .049 | .031 | .275 | .0 | .0 | .0 |
| | 02 | 03 | 08 | 45 | 03 | 29 | 74 | 98 | 88 | 00 | **00** | | 03 | 78 | **01** | **00** | 77 | 00 | 0 | 6 | 5 | 7 | | | | | 24 | 16 | 57 |
| **CF 4** | .3 | .3 | .0 | .4 | .1 | .2 | .2 | .4 | .2 | .0 | **.0** | **.0** | | .0 | **.2** | **.2** | .1 | .1 | .00 | .45 | .11 | .47 | .337 | .353 | .484 | .030 | .1 | .2 | .1 |
| | 26 | 44 | 97 | 67 | 84 | 43 | 40 | 16 | 64 | 00 | **01** | **03** | | 11 | **53** | **03** | 72 | 21 | 1 | 5 | 6 | 2 | | | | | 15 | 16 | 26 |
| **CF 5** | .0 | .0 | .0 | .1 | .4 | .3 | .0 | .1 | .2 | .2 | **.4** | **.3** | .0 | | **.2** | **.2** | .1 | .3 | .03 | .05 | .14 | .04 | .037 | .034 | .201 | .393 | .0 | .0 | .0 |
| | 25 | 74 | 46 | 20 | 45 | 06 | 71 | 78 | 31 | 62 | **22** | **78** | 11 | | **73** | **69** | 03 | 12 | 0 | 2 | 0 | 2 | | | | | 15 | 42 | 06 |
| **DA 1** | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .1 | .2 | .0 | **.0** | **.0** | .2 | .2 | | **.0** | .0 | .0 | .46 | .00 | .00 | .00 | .000 | .000 | .009 | .250 | .0 | .0 | .0 |
| | 00 | 00 | 00 | 00 | 00 | 03 | 42 | 04 | 00 | 05 | **00** | **01** | 53 | 73 | | **00** | 00 | 00 | 8 | 0 | 0 | 0 | | | | | 00 | 00 | 00 |
| **DA 2** | .0 | .0 | .0 | .0 | .0 | .0 | .2 | .0 | .0 | .0 | **.0** | **.0** | .2 | .2 | **.0** | | .0 | .0 | .45 | .00 | .00 | .00 | .000 | .000 | .009 | .473 | .0 | .0 | .0 |
| | 00 | 00 | 00 | 00 | 00 | 01 | 32 | 26 | 80 | 02 | **01** | **00** | 03 | 69 | **00** | | 00 | 00 | 3 | 0 | 0 | 0 | | | | | 00 | 00 | 00 |
| **DA 3** | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .0 | .0 | .0 | **.0** | **.0** | .1 | .1 | **.0** | **.0** | | .0 | .17 | .00 | .00 | .00 | .000 | .000 | .126 | .029 | .0 | .0 | .0 |
| | 00 | 00 | 00 | 00 | 00 | 06 | 48 | 21 | 24 | 87 | **37** | **77** | 72 | 03 | **00** | **00** | | 00 | 2 | 0 | 7 | 0 | | | | | 00 | 00 | 00 |

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| **DA4** | .000 | .000 | .000 | .000 | .000 | .006 | .135 | .080 | .070 | .001 | **.000** | **.000** | .121 | .312 | **.000** | **.000** | .000 | | .415 | .000 | .000 | .000 | .000 | .000 | .001 | .319 | .000 | .000 | .000 |
| DSN1 | .109 | .492 | .096 | .047 | .080 | .046 | .030 | .003 | .019 | .047 | **.026** | **.070** | .001 | .030 | **.068** | **.053** | .072 | .015 | | .043 | .000 | .217 | .444 | .440 | .401 | .016 | .232 | .183 | .145 |
| DSN2 | .000 | .000 | .000 | .000 | .000 | .018 | .018 | .002 | .022 | .083 | **.066** | **.076** | .055 | .052 | **.000** | **.000** | .000 | .000 | .043 | | .003 | .000 | .000 | .001 | .023 | .360 | .000 | .000 | .000 |
| DSN3 | .000 | .001 | .006 | .001 | .017 | .023 | .086 | .007 | .019 | .004 | **.053** | **.015** | .016 | .040 | **.000** | **.000** | .007 | .000 | .000 | .003 | | .025 | .016 | .002 | .068 | .104 | .000 | .001 | .001 |
| DSN4 | .001 | .002 | .002 | .000 | .000 | .093 | .005 | .003 | .023 | .070 | **.082** | **.067** | .072 | .042 | **.000** | **.000** | .000 | .000 | .217 | .000 | .025 | | .001 | .000 | .030 | .220 | .000 | .000 | .000 |
| DPBC1 | .000 | .000 | .000 | .000 | .000 | .000 | .065 | .010 | .021 | .019 | **.047** | **.060** | .037 | .037 | **.000** | **.000** | .000 | .000 | .444 | .000 | .016 | .001 | | .000 | .491 | .119 | .000 | .000 | .000 |
| DPBC2 | .000 | .000 | .000 | .000 | .001 | .071 | .070 | .048 | .092 | .031 | **.076** | **.049** | .053 | .034 | **.000** | **.000** | .000 | .000 | .440 | .001 | .002 | .000 | .000 | | .075 | .373 | .000 | .000 | .000 |
| DPBC3 | .003 | .001 | .027 | .016 | .019 | .098 | .043 | .040 | .025 | .016 | **.068** | **.031** | .084 | .011 | **.009** | **.009** | .026 | .001 | .401 | .023 | .068 | .030 | .491 | .075 | | .004 | .000 | .000 | .000 |
| DPBC4 | .100 | .184 | .038 | .049 | .018 | .021 | .070 | .006 | .032 | .021 | **.052** | **.075** | .030 | .093 | **.050** | **.073** | .029 | .019 | .016 | .360 | .104 | .220 | .119 | .373 | .004 | | .467 | .031 | .044 |

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| | INT 1 | .000 | .000 | .000 | .000 | .000 | .012 | .021 | .006 | .051 | .037 | **.030** | **.024** | .15 | .15 | **.000** | **.000** | .000 | .000 | .23 2 | .000 | .000 | .000 | .000 | .000 | .092 | .467 | | .000 | .000 |
| | INT 2 | .000 | .000 | .000 | .000 | .000 | .003 | .057 | .022 | .088 | .022 | **.051** | **.016** | .16 | .42 | **.000** | **.000** | .000 | .000 | .18 3 | .000 | .000 | .000 | .000 | .000 | .002 | .131 | .000 | | .000 |
| | INT 3 | .000 | .000 | .000 | .000 | .000 | .001 | .032 | .003 | .034 | .069 | **.032** | **.057** | .26 | .06 | **.000** | **.000** | .000 | .000 | .14 5 | .000 | .000 | .000 | .000 | .000 | .028 | .344 | .000 | .000 | |

a. Determinant = 6.12E-017

## Appendix 11 Second draft (v2) of Medicine Reuse Questionnaire (MRQ) after first piloting

| |
|---|
| 1. Reusing medication in the future is *Harmful 1 2 3 4 5 6 7 beneficial* |
| 2. Reusing medication in the future is *good 1 2 3 4 5 6 7 bad* |
| 3. Reusing medication in the future is *satisfying (for me) 1 2 3 4 5 6 7 dissatisfying (for me)* |
| 4. Reusing medication in the future is *worthless 1 2 3 4 5 6 7 worthwhile* |
| 5. Most people whose opinions I value, would approve of my decision to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 6. Most people who are important to me would want me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 7. It would be expected of me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 8. Most people who are important to me would think that ---------- reuse medication in the future *I should 1 2 3 4 5 6 7 I should not* |
| 9. I expect to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 10. I want to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 11. I intend to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 12. I am confident that I could reuse medication in the future if I wanted to *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 13. For me to reuse medication in the future is *possible 1 2 3 4 5 6 7 impossible* |
| 14. The decision to reuse medication in the future is within my control *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 15. Whether or not I reuse medication in the future is completely up to me *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 16. I think for me to contribute toward reducing the harmful effects of medication on the environment is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 17. I think for me to contribute toward reducing the NHS drug expenditure is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 18. I think for me to receive low quality medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 19. I think for me to receive unsafe medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 20. I think for me to receive incorrect medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 21. Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 22. Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |

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| 23. Reusing sealed, returned blister-pack medication will result in me receiving low quality medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 24. Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 25. Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 26. My doctor would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 27. My pharmacist would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 28. My close friends would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 29. My family would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 30. Generally speaking, how much do you want to do what your doctor believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 31. Generally speaking, how much do you want to do what your pharmacist believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 32. Generally speaking, how much do you want to do what close friends believe you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 33. Generally speaking, how much do you want to do what your family believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 34. I expect that any medication offered to me for reuse will be in the original, sealed, blister-packaging *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 35. I expect to see evidence that any medication offered to me for reuse would have been quality-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 36. I expect to see evidence that any medication offered to me for reuse would have been safety-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 37. I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining *definitely no 1 2 3 4 5 6 7 definitely yes* |

38. It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister-packaging *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

39. It would make it easier for me to reuse medication if I could see that it had been quality-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

40. It would make it easier for me to reuse medication if I could see that it had been safety-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

41. It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

42. Are you currently taking medication for a long term condition?

a) Yes
b) No

43. Choose one option that best describes your age range?

a) 25 or under
b) 26-40
c) 41-55
d) 56 or older
e) I prefer not to say

44. What is your gender?

a) Male
b) Female
c) Other (please specify here)
d) I prefer not to say

45. What is your religion?

a) No religion
b) Christian (including Church of England, Catholic, Protestant and all other Christian denominations)
c) Muslim
d) Jewish
e) Buddhist
f) Hindu
g) Sikh
h) Other

i) I prefer not to say

46. Choose one option that best describes your ethnicity?

a) White (English / Welsh / Scottish / Northern Irish/British)
b) White (Irish)
c) White (Gypsy or Irish traveller)
d) Any other White background, please describe below
e) Mixed / Multiple ethnic groups (White and Black Caribbean)
f) Mixed / Multiple ethnic groups (White and Black African)
g) Mixed / Multiple ethnic groups (White and Asian)
h) Any other Mixed / Multiple ethnic background, please describe here
i) Asian / Asian British (Indian)
j) Asian / Asian British (Pakistani)
k) Asian / Asian British (Bangladeshi)
l) Asian / Asian British (Chinese)
m) Any other Asian background, please describe here
n) Black / Black British (African)
o) Black / Black British (Caribbean)
p) Any other Black / African / Caribbean background, please describe below
q) Arab
r) Any other ethnic group, please describe here
b) I prefer not to say

47. Choose one option that best describes your highest level of educational achievement?

a) University Higher Degree (e.g. MSc, PhD)
b) First degree level qualification including foundation degrees, graduate membership of a
c) professional Institute, PGCE
d) Diploma in higher education
e) Teaching qualification (excluding PGCE)
f) Nursing or other medical qualification not yet mentioned
g) A Level
h) Welsh Baccalaureate
i) International Baccalaureate

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| j) AS Level<br>k) Higher Grade/Advanced Higher (Scotland)<br>l) Certificate of sixth year studies<br>m) GCSE/O Level<br>n) CSE<br>o) Standard/Ordinary (O) Grade / Lower (Scotland)<br>p) Other school (including school leaving exam certificate or matriculation)<br>q) I prefer not to say<br>b) Other |
| 48. If you have any comments, or ideas regarding the concept of medication reuse, please share them here |

**Appendix 12 Third draft (v3) of Medicine Reuse Questionnaire (MRQ) after second piloting that required only CFA analysis and alpha (α) coefficient (direct measures and intention construct)**

| |
|---|
| 1. Reusing medication in the future is *Harmful 1 2 3 4 5 6 7 beneficial* |
| 2. Reusing medication in the future is *good 1 2 3 4 5 6 7 bad* |
| 3. Reusing medication in the future is *satisfying (for me) 1 2 3 4 5 6 7 dissatisfying (for me)* |
| 4. Reusing medication in the future is *worthless 1 2 3 4 5 6 7 worthwhile* |
| 5. Most people whose opinions I value, would approve of my decision to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 6. Most people who are important to me would want me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 7. It would be expected of me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 8. Most people who are important to me would think that ---------- reuse medication in the future *I should 1 2 3 4 5 6 7 I should not* |
| 9. I expect to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 10. I want to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 11. I intend to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 12. I am confident that I could reuse medication in the future if I wanted to *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 13. For me to reuse medication in the future is *possible 1 2 3 4 5 6 7 impossible* |
| 14. I think for me to contribute toward reducing the harmful effects of medication on the environment is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 15. I think for me to contribute toward reducing the NHS drug expenditure is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 16. I think for me to receive low quality medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 17. I think for me to receive unsafe medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 18. I think for me to receive incorrect medication is *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 19. Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 20. Reusing sealed, returned blister-pack medication will help me contribute toward reducing NHS drug expenditure *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 21. Reusing sealed, returned blister-pack medication will result in me receiving low quality medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |

| |
|---|
| 22. Reusing sealed, returned blister-pack medication will result in me receiving unsafe medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 23. Reusing sealed, returned blister-pack medication will result in me receiving incorrect medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 24. My doctor would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 25. My pharmacist would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 26. My close friends would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 27. My family would believe that I should reuse sealed, returned blister-pack medication *definitely disagree -3 -2 -1 0 1 2 3 definitely agree* |
| 28. Generally speaking, how much do you want to do what your doctor believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 29. Generally speaking, how much do you want to do what your pharmacist believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 30. Generally speaking, how much do you want to do what close friends believe you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 31. Generally speaking, how much do you want to do what your family believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 32. I expect that any medication offered to me for reuse will be in the original, sealed, blister-packaging *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 33. I expect to see evidence that any medication offered to me for reuse would have been quality-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 34. I expect to see evidence that any medication offered to me for reuse would have been safety-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 35. I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 36. It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister-packaging *strongly disagree -3 -2 -1 0 1 2 3 strongly agree* |

37. It would make it easier for me to reuse medication if I could see that it had been quality-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

38. It would make it easier for me to reuse medication if I could see that it had been safety-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

39. It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining *strongly disagree -3 -2 -1 0 1 2 3 strongly agree*

40. Are you currently taking medication for a long term condition?

a) Yes
b) No

41. Choose one option that best describes your age range?

a) 25 or under
b) 26-40
c) 41-55
d) 56 or older
e) I prefer not to say

42. What is your gender?

a) Male
b) Female
c) Other (please specify here)
d) I prefer not to say

43. What is your religion?

a) No religion
b) Christian (including Church of England, Catholic, Protestant and all other Christian denominations)
c) Muslim
d) Jewish
e) Buddhist
f) Hindu
g) Sikh
h) Other
i) I prefer not to say

44. Choose one option that best describes your ethnicity?

a) White (English / Welsh / Scottish / Northern Irish/British)
b) White (Irish)
c) White (Gypsy or Irish traveller)
d) Any other White background, please describe below
e) Mixed / Multiple ethnic groups (White and Black Caribbean)
f) Mixed / Multiple ethnic groups (White and Black African)
g) Mixed / Multiple ethnic groups (White and Asian)
h) Any other Mixed / Multiple ethnic background, please describe here
i) Asian / Asian British (Indian)
j) Asian / Asian British (Pakistani)
k) Asian / Asian British (Bangladeshi)
l) Asian / Asian British (Chinese)
m) Any other Asian background, please describe here
n) Black / Black British (African)
o) Black / Black British (Caribbean)
p) Any other Black / African / Caribbean background, please describe below
q) Arab
r) Any other ethnic group, please describe here
c) I prefer not to say

45. Choose one option that best describes your highest level of educational achievement?
a) University Higher Degree (e.g. MSc, PhD)
b) First degree level qualification including foundation degrees, graduate membership of a
c) professional Institute, PGCE
d) Diploma in higher education
e) Teaching qualification (excluding PGCE)
f) Nursing or other medical qualification not yet mentioned
g) A Level
h) Welsh Baccalaureate
i) International Baccalaureate
j) AS Level
k) Higher Grade/Advanced Higher (Scotland)

| |
|---|
| l) Certificate of sixth year studies<br>m) GCSE/O Level<br>n) CSE<br>o) Standard/Ordinary (O) Grade / Lower (Scotland)<br>p) Other school (including school leaving exam certificate or matriculation)<br>q) I prefer not to say<br>c) Other |
| 46. If you have any comments, or ideas regarding the concept of medication reuse, please share them here |

**Appendix 13 Final version (v4) of Medicine Reuse Questionnaire (MRQ) which was disseminated nationwide to capture people's beliefs and willingness to reuse medicine in the future.**

**Data Protection**

Researchers from the University of Reading would like to ask your opinion about a potentially personal or sensitive topic. Please be assured that all the answers will be treated as confidential and will be used for market research purposes. All data will be processed in adherence to Market Research Society's Code of Conduct and Data Protection Act 1998. All data collected in this survey will be held anonymously and securely. No personal identifying data is asked for or retained. Cookies and personal data stored by your web browser are not used in this survey. This study has received research ethics approval as per the University of Reading Research Ethics Committee procedures.

**Is this the right survey for you?**

1. We are interested in the views of people with a long term health condition only. Do you currently have a long term health condition?

a) Yes

b) No

**Please help by providing some more information about you**

2. Which of the following (or another) long term health condition(s) do you have?

a) High blood pressure
b) Depression
c) Diabetes
d) Asthma
e) Chronic kidney disease
f) Condition affecting the heart (coronary heart disease, atrial fibrillation, heart failure)
g) Chronic obstructive pulmonary disease (COPD)
h) Cancer
i) Arthritis
j) Epilepsy
k) Osteoporosis
l) Inflammatory bowel disease (Crohn's disease or ulcerative colitis)
m) Others, please specify here

3. Are you currently taking any type of medication for your long term condition(s)?

a) Yes
b) No, but I have done in the past
c) No, and I have never taken any medication for my long term condition(s)

4. Choose one option that best describes your age range?

a) 18 or 19

b) 20-24
c) 25-29
d) 30-34
e) 35-39
f) 40-44
g) 45-49
h) 50-54
i) 55-59
j) 60-64
k) 65-69
l) 70-74
m) 75-79
n) 80 or over
o) I prefer not to say

5. What is your gender?

a) Male
b) Female
c) Other (please specify here)
d) I prefer not to say

6. Choose one option that best describes your ethnicity?

a) White (English / Welsh / Scottish / Northern Irish/British)
b) White (Irish)
c) White (Gypsy or Irish traveller)
d) Any other White background, please describe below
e) Mixed / Multiple ethnic groups (White and Black Caribbean)
f) Mixed / Multiple ethnic groups (White and Black African)
g) Mixed / Multiple ethnic groups (White and Asian)
h) Any other Mixed / Multiple ethnic background, please describe here
i) Asian / Asian British (Indian)
j) Asian / Asian British (Pakistani)
k) Asian / Asian British (Bangladeshi)
l) Asian / Asian British (Chinese)
m) Any other Asian background, please describe here
n) Black / Black British (African)
o) Black / Black British (Caribbean)
p) Any other Black / African / Caribbean background, please describe below
q) Arab
r) Any other ethnic group, please describe here
s) I prefer not to say

7. Choose one option that best describes your highest level of educational achievement?

a) University Higher Degree (e.g. MSc, PhD)
b) First degree level qualification including foundation degrees, graduate membership of a
c) professional Institute, PGCE
d) Diploma in higher education
e) Teaching qualification (excluding PGCE)
f) Nursing or other medical qualification not yet mentioned
g) A Level
h) Welsh Baccalaureate
i) International Baccalaureate
j) AS Level
k) Higher Grade/Advanced Higher (Scotland)
l) Certificate of sixth year studies
m) GCSE/O Level
n) CSE
o) Standard/Ordinary (O) Grade / Lower (Scotland)
p) Other school (including school leaving exam certificate or matriculation)
q) I prefer not to say
r) Other

8. In which region of the UK do you currently live?

a) East of England

b) East Midlands
c) London
d) North East and Cumbria
e) Northern Ireland
f) North West
g) Scotland
h) South East
i) South West
j) Cymru Wales
k) West Midlands
l) Yorkshire and the Humber
m) Other, please specify here

**Survey about reusing medication**

Welcome to a survey about reusing medication. The survey is completed anonymously. The survey can be saved part way through and takes 20 minutes to complete. The aim of this survey is to learn about your beliefs in relation to the concept of reusing medication. We want to know if you would personally consider reusing medication in the future. We define reusing medication as the idea that you would accept for your own personal use a prescription medication that has been previously given out to another patient but then returned to a pharmacy, where the pharmacist has verified that the medication: has been kept by the other patient for less than three

months, has more than 6 months of shelf-life remaining, has not been tampered with, has been kept under normal storage conditions, and has been kept in an original sealed blister pack (i.e. medication strip). When we refer to reusing medication, we are interested in prescribed medication that an individual/patient may use for a long term illness. The individual/patient would be well enough to make their own healthcare decisions.

**How to complete this survey?**

The survey focusses on concepts relating to reusing sealed, returned blister-pack medication. We would like to highlight that reusing medication is not currently permitted in the UK so this questionnaire is phrased in relation to the future only. In the main section below, we ask your opinion using rating scales; please select the button that best represents your opinion along each answer line provided. Please read each question carefully and answer all the questions to the best of your ability. There are no right or wrong responses; we are just interested in your personal point of view. If you are not currently taking prescribed medication for your long term condition, we are still interested in receiving your views. We simply ask that you answer the questions as though you were receiving prescribed medication for your long term condition. We will now proceed to the main survey section.

**2. Main section**

9. Complete the following sentence: Reusing medication in the future is *Harmful 1 2 3 4 5 6 7 beneficial*

10. Complete the following sentence: Reusing medication in the future is *good 1 2 3 4 5 6 7 bad*

11. Complete the following sentence: Reusing medication in the future is *satisfying (for me) 1 2 3 4 5 6 7 dissatisfying (for me)*

| |
|---|
| 12. Complete the following sentence: Reusing medication in the future is *worthless 1 2 3 4 5 6 7 worthwhile* |
| 13. How far do you agree with the following statement: Most people whose opinions I value, would approve if I decided to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 14. How far do you agree with the following statement: Most people who are important to me would want me to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 15. How far do you agree with the following statement: I would be expected by others to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 16. Complete the following sentence: Most people who are important to me would think that [.....] reuse medication in the future *I should 1 2 3 4 5 6 7 I should not* |
| 17. How far do you agree with the following statement: I expect to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 18. How far do you agree with the following statement: I want to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 19. How far do you agree with the following statement: I intend to reuse medication in the future *strongly disagree 1 2 3 4 5 6 7 strongly agree* |

| |
|---|
| 20. How far do you agree with the following statement: I am confident that I could reuse medication in the future if I wanted to *strongly disagree 1 2 3 4 5 6 7 strongly agree* |
| 21. Complete the following sentence: For me it is [.....] to reuse medication in the future is *possible 1 2 3 4 5 6 7 impossible* |
| 22. Complete the following sentence: I think for me to contribute toward reducing the harmful effects of medication on the environment is [.....] *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 23. Complete the following sentence: I think for me to contribute toward reducing the amount of money spent by the NHS on medication is [.....] *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 24. Complete the following sentence: I think for me to receive low quality medication is [.....] *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 25. Complete the following sentence: I think for me to receive unsafe medication is [.....] *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 26. Complete the following sentence: I think for me to receive incorrect medication is [.....] *extremely bad 1 2 3 4 5 6 7 extremely good* |
| 27. How far do you agree with the following statement: Reusing sealed, returned blister-pack medication will help me contribute toward reducing the harmful effects of medication on the environment *definitely disagree 1 2 3 4 5 6 7 definitely agree* |

| |
|---|
| 28. How far do you agree with the following statement: Reusing sealed, returned blister-pack medication will help me contribute toward reducing the amount of money spent by the NHS on medication *definitely disagree 1 2 3 4 5 6 7 definitely agree* |
| 29. Complete the following sentence: Reusing sealed, returned blister-pack medication is [.....] to result in me receiving low quality medication *extremely unlikely 1 2 3 4 5 6 7 extremely likely* |
| 30. Complete the following sentence: Reusing sealed, returned blister-pack medication is [.....] to result in me receiving unsafe medication *extremely unlikely 1 2 3 4 5 6 7 extremely likely* |
| 31. Complete the following sentence: Reusing sealed, returned blister-pack medication is [.....] to result in me receiving incorrect medication *extremely unlikely 1 2 3 4 5 6 7 extremely likely* |
| 32. How far do you agree with the following statement: My doctor would believe that I should reuse sealed, returned blister-pack medication *definitely disagree 1 2 3 4 5 6 7 definitely agree* |
| 33. How far do you agree with the following statement: My pharmacist would believe that I should reuse sealed, returned blister-pack medication *definitely disagree 1 2 3 4 5 6 7 definitely agree* |
| 34. How far do you agree with the following statement: My close friends would believe that I should reuse sealed, returned blister-pack medication *definitely disagree 1 2 3 4 5 6 7 definitely agree* |
| 35. How far do you agree with the following statement: My family would believe that I should reuse sealed, returned blister-pack medication *definitely disagree 1 2 3 4 5 6 7 definitely agree* |

| |
|---|
| 36. Answer the following question: Generally speaking, how much do you want to do what your doctor believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 37. Answer the following question: Generally speaking, how much do you want to do what your pharmacist believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 38. Answer the following question: Generally speaking, how much do you want to do what your close friends believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 39. Answer the following question: Generally speaking, how much do you want to do what your family believes you should do? *Not at all 1 2 3 4 5 6 7 very much* |
| 40. Do you agree with the following statement: I expect that any medication offered to me for reuse will be in the original, sealed, blister packaging *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 41. Do you agree with the following statement: I expect to see evidence that any medication offered to me for reuse would have been quality-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 42. Do you agree with the following statement: I expect to see evidence that any medication offered to me for reuse would have been safety-checked *definitely no 1 2 3 4 5 6 7 definitely yes* |
| 43. Do you agree with the following statement: I expect that any medication offered to me for reuse will have more than six months of shelf-life remaining *definitely no 1 2 3 4 5 6 7 definitely yes* |

| |
|---|
| 44. How far do you agree with the following statement: It would make it easier for me to reuse medication if I could see that it was in the original, sealed, blister packaging *strongly disagree -3 -2 -1 0 1 2 3 strongly agree* |
| 45. How far do you agree with the following statement: It would make it easier for me to reuse medication if I could see that it had been quality-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree* |
| 46. How far do you agree with the following statement: It would make it easier for me to reuse medication if I could see that it had been safety-checked *strongly disagree -3 -2 -1 0 1 2 3 strongly agree* |
| 47. How far do you agree with the following statement: It would make it easier for me to reuse medication if I could see that it had more than six months of shelf-life remaining *strongly disagree -3 -2 -1 0 1 2 3 strongly agree* |
| 48. If you have any comments, or ideas regarding the concept of medication reuse, please share them here |

## Appendix 14 Correlation matrix between independent (predictor) variables

**Correlations**

| | | ID | AD | SND | PBCD | BBIN | NBIN | CBIN |
|---|---|---|---|---|---|---|---|---|
| Pearson Correlation | ID | 1.000 | **.736** | **.804** | **.732** | **.541** | **.550** | **.192** |
| | AD | .736 | 1.000 | **.743** | .637 | .591 | .497 | .191 |
| | SND | .804 | **.743** | 1.000 | .669 | .525 | .582 | .135 |
| | PBCD | .732 | .637 | .669 | 1.000 | .539 | .468 | .219 |
| | BBIN | .541 | .591 | .525 | .539 | 1.000 | .579 | .271 |
| | NBIN | .550 | .497 | .582 | .468 | .579 | 1.000 | .190 |
| | CBIN | **.192** | **.191** | **.135** | **.219** | **.271** | **.190** | 1.000 |
| Sig. (1-tailed) | ID | . | .000 | .000 | .000 | .000 | .000 | .000 |
| | AD | .000 | . | .000 | .000 | .000 | .000 | .000 |
| | SND | .000 | .000 | . | .000 | .000 | .000 | .000 |
| | PBCD | .000 | .000 | .000 | . | .000 | .000 | .000 |
| | BBIN | .000 | .000 | .000 | .000 | . | .000 | .000 |
| | NBIN | .000 | .000 | .000 | .000 | .000 | . | .000 |
| | CBIN | .000 | .000 | .000 | .000 | .000 | .000 | . |
| N | ID | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |
| | AD | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |
| | SND | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |
| | PBCD | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |
| | BBIN | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |
| | NBIN | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |
| | CBIN | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 | 1003 |

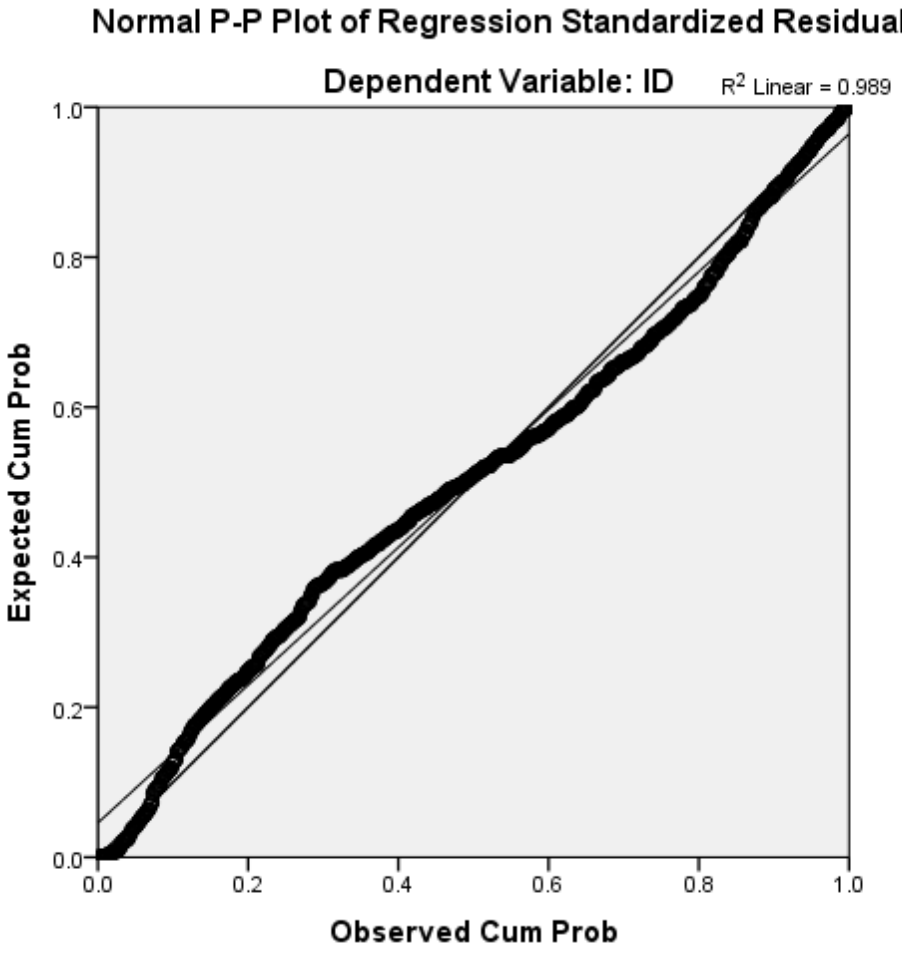
## Appendix 15 The multicollinearity diagnostic test (the coefficient output)

**Coefficients[a]**

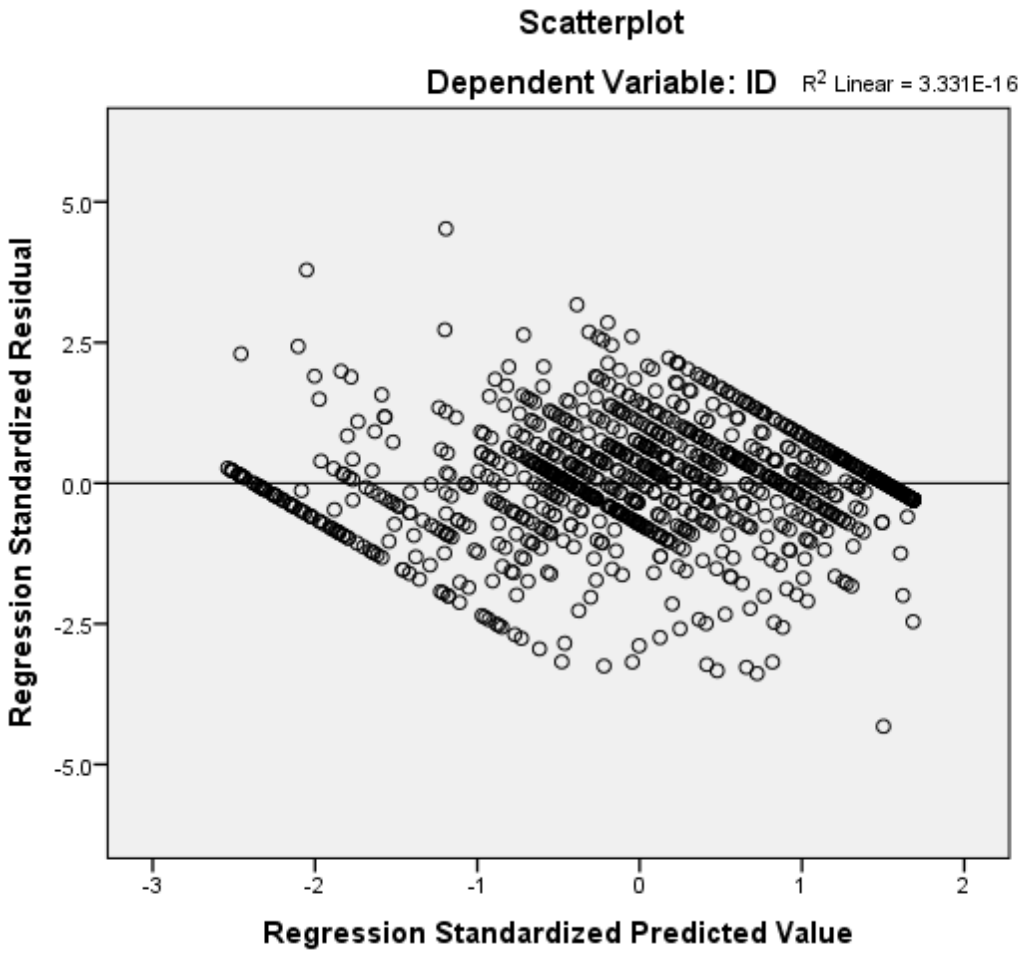
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Zero-order | Partial | Part | **Tolerance** | **VIF** |
| 1 | (Constant) | -.004 | .124 | | -.034 | .973 | -.247 | .239 | | | | | |
| | AD | .201 | .026 | .206 | 7.775 | .000 | .150 | .252 | .736 | .239 | .126 | **.376** | **2.659** |
| | SND | .468 | .031 | .419 | 15.116 | .000 | .407 | .528 | .804 | .432 | .245 | **.342** | **2.921** |
| | PBCD | .312 | .026 | .283 | 12.092 | .000 | .262 | .363 | .732 | .358 | .196 | **.479** | **2.088** |
| | BBIN | .000 | .001 | .003 | .137 | .891 | -.002 | .002 | .541 | .004 | .002 | **.510** | **1.960** |
| | NBIN | .003 | .001 | .066 | 3.040 | .002 | .001 | .006 | .550 | .096 | .049 | **.557** | **1.796** |
| | CBIN | .001 | .001 | .021 | 1.224 | .221 | -.001 | .003 | .192 | .039 | .020 | **.911** | **1.098** |

a. Dependent Variable: ID

**Appendix 16 Normal P-P plot of regression standardised residual, the points (line) lied in a reasonably straight diagonal line from bottom left to top right confirmed no major deviation from normality**



**Appendix 17 Scatter plot of the standardised residuals, roughly rectangular distributed, with most of the scores concentrated in the centres (along the 0 point).**



## Appendix 18 Model summary table and ANOVA table, showed the P value of the model summary

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .859[a] | **.738** | .736 | .923 | **1.951** |

a. Predictors: (Constant), CBIN, SND, BBIN, NBIN, PBCD, AD

b. Dependent Variable: ID

**ANOVA table, showed the P value of the model summary**

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2387.287 | 6 | 397.881 | 467.488 | .000[b] |
| | Residual | 847.699 | 996 | .851 | | |
| | Total | 3234.987 | 1002 | | | |

a. Dependent Variable: ID

b. Predictors: (Constant), CBIN, SND, BBIN, NBIN, PBCD, AD

## Appendix 19 Simple bivariate correlation between the direct and indirect measures of the same construct of TPB

**Correlations between direct measure of attitude (AD) and indirect measure of behavioural belief**

| | | AD | BBIN |
|---|---|---|---|
| AD | Pearson Correlation | 1 | .591** |
| | Sig. (2-tailed) | | .000 |
| | N | 1003 | 1003 |
| BBIN | Pearson Correlation | .591** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 1003 | 1003 |

**. Correlation is significant at the 0.01 level (2-tailed).

**Correlations between direct measure of subjective norm (SND) and indirect measure of normative belief (NBIN)**

| | | SND | NBIN |
|---|---|---|---|
| SND | Pearson Correlation | 1 | .582** |
| | Sig. (2-tailed) | | .000 |
| | N | 1003 | 1003 |
| NBIN | Pearson Correlation | .582** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 1003 | 1003 |

**. Correlation is significant at the 0.01 level (2-tailed).

**Correlations between direct measure of PBCD and indirect measure of control belief (CBIN)**

| | | PBCD | CBIN |
|---|---|---|---|
| PBCD | Pearson Correlation | 1 | .219** |
| | Sig. (2-tailed) | | .000 |
| | N | 1003 | 1003 |
| CBIN | Pearson Correlation | .219** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 1003 | 1003 |

**. Correlation is significant at the 0.01 level (2-tailed).