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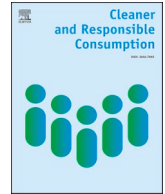
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Motivation or Inconvenience—What matters most? Understanding recycling behavior of healthcare waste

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ABSTRACT

Recycling programs are widely used to address global environmental challenges, with the active participation of end users being crucial for the successful return of products at the end of use. However, individuals have different motivations for recycling and face various obstacles in doing so. We lack an understanding of these motivations and the inconveniences of engaging in this behavior, especially within the healthcare industry. By drawing insights from the take-back program ReturpenTM, which was introduced in Denmark and the UK, this study addresses how different types of motivation influence end-user participation in take-back programs and the extent to which motivation offsets the inconveniences. The results showed that individuals' underlying motivations vary, with altruism emerging as the primary motivator, followed by social norms, while direct personal benefits play a relatively minor role. While 92% of respondents indicated their intention to engage in the take-back program, the actual return rate in the Danish program was approximately 22%, which points to a clear intention-behavior gap.

1. Introduction

Each year, more than two billion tons of municipal solid waste are produced worldwide, with at least 33% of managed in a manner that is not environmentally safe (Kaza et al., 2018). The healthcare industry is one of the largest consumers of single-use products, including syringes, gloves, and injection pens. Over time, (single use) plastics have largely replaced materials like steel and glass in this industry, primarily due to their disposability, their effectiveness in preventing infections owing to their sterility, and their safety in medical practices (Kibria et al., 2023; Joseph et al., 2021; Rigamonti et al., 2014).

Some companies are adopting take-back programs in which used products are returned to the manufacturer to prolong material life, minimize waste, and reduce the use of raw materials (Lewandowski, 2016). For a take-back program to be viable, active end-user participation is essential, as they must return the used products (typically to a collection point) at the end of use. However, despite positive intentions, end users often fail to participate. Thus, several studies have highlighted the importance of understanding what motivates end users to participate in these programs and, more generally, in recycling (Terzioğlu, 2021; Li et al., 2021). Previous research in different sectors has identified several factors that influence recycling behavior, but the healthcare industry's

unique regulatory landscape, operational complexities, and specific waste-management requirements related to contamination and safety can complicate the effects of these factors. For instance, some of the most recognized motivational factors include monetary and tangible incentives (Wang et al., 2023), which may not be allowed in the healthcare sector due to regulations. Efforts to enhance convenience and facilitate the return of used products (Lawrence et al., 2020) may also be limited by hygiene and safety protocols. Moreover, information and awareness (Northen et al., 2023) may not be prioritized if they are perceived as conflicting with the priorities of patient safety, compliance, or clinical matters. Consequently, barriers and inconveniences can overshadow well-intentioned recycling efforts.

The medical company Novo Nordisk A/S and its competitors developed and implemented a take-back program for disposable, single-use injection pens called ReturpenTM in Denmark and Pen Cycle in the UK (Mallick et al., 2022). The take-back program did not offer any tangible rewards to users for returning their pens. Thus, it was based solely on users' voluntary actions and recycling behavior, which allows us to assume that their motivation to participate came from a desire to do good for others. This take-back program setting serves as an excellent context for studying the motivation and segmentation of users and their recycling behaviors.

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To understand users' motivations, we followed Returpen for three years—from the pilot phase in 2021 to national scaling by Novo Nordisk and the inclusion of more companies in 2024. We conducted two surveys of users of injection pens in 2021 to estimate their intention to participate in the take-back program. One survey focused on pen users in Denmark and resulted in 597 responses. The other focused on pen users in the UK and resulted in 202 responses. The two surveys were largely identical and included many of the same questions, which allows us to compare results across the two countries to capture more basic human motivations. The aim of the surveys was to reveal the drivers and barriers that influence end user's motivations to recycle and their recycling behavior. By comparing the expressed recycling intentions with actual return rates, we can also identify discrepancies between intentions and recycling behavior.

Given the substantial volumes of medical waste generated by the healthcare industry and the limited research conducted thus far on recycling behavior within this sector, this case offered a unique opportunity to examine recycling practices in this field. As such, our research fills an important gap in the extant literature by examining real-world recycling behavior in the healthcare industry. It provides valuable insights into why individuals may not always follow through on their recycling intentions and offers practical suggestions for the design and optimization of take-back programs.

In the following, we first review the literature on motivation with the aim of understanding the different types of motivation and behavior as well as the inconveniences associated with participating in recycling programs. Based on these insights, we analyze the data from our two large surveys and multiple in-depth interviews as well as pen-return rates. This explorative approach enables us to understand why people participate (or do not participate) in take-back programs.

2. Motivations and inconvenience for recycling behavior

Motivation—a fundamental concept in psychology—refers to the processes that initiate, guide, and sustain behaviors. According to Ryan and Deci (2000, p. 1), a person who is motivated is activated or energized toward an end or “moved to do something,” while a person with no impetus or inspiration is considered unmotivated. Motivation plays a crucial role in shaping behavior because it determines how individuals approach tasks and make decisions. In the context of recycling behavior, motivation can explain why some individuals actively participate in take-back programs and others refrain. Therefore, motivating people in the context of a take-back program is important because such motivation drives the necessary behavioral change, encourages sustained participation, and helps overcome resistance or barriers, thereby ensuring the program's long-term success and positive environmental impact.

Most motivation theories focus on the extent to which a person is motivated, which can range from very little to very much. However, as people can be motivated in different ways, the *type* of motivation also matters. While the extent of motivation indicates the amount of effort someone might put in, the type of motivation helps explain the underlying reasons for doing so (Ryan and Deci, 2000). The most basic distinction of types of motivation is between intrinsic and extrinsic (Hornik et al., 1995). Intrinsic motivation encompasses altruism, where individuals engage in recycling because of an internal drive to positively affect the environment and contribute to the greater good. Extrinsic motivation centers around direct personal benefits, such as tangible rewards or discounts that encourage participation in recycling programs. Social norms represent a blend of both intrinsic and extrinsic motivations. For instance, individuals may feel compelled to recycle due to peer influence but also consider personal rewards.

2.1. Direct personal benefits (direct reciprocity)

One key motivation for recycling behavior is the pursuit of direct personal benefits. This type of motivation entails engaging in activities

primarily to gain external rewards (e.g., financial incentives or public recognition) or to avoid negative consequences (e.g., penalties) (Ryan and Deci, 2000). Essentially, individuals are motivated by the expectation of receiving a tangible return for their actions. This exchange of benefits or actions occurs when individuals are motivated by the expectation of receiving a benefit in return (Kolm, 2006). As such, this type of motivation operates on the premise that individuals are more likely to engage in recycling when they expect immediate or tangible rewards for their actions. The principle of direct reciprocity can be likened to a “tit-for-tat” exchange in which actions are mutually beneficial. This type of motivation functions on a transactional basis, where individuals are more inclined to recycle when they anticipate a direct benefit from their efforts within a defined timeframe.

Research has shown that financial incentives can significantly boost recycling behavior, especially among individuals with less emotional attachment to the recycled product (Li et al., 2021). Examples of such incentives include cash-back rewards or deposit schemes (Northen et al., 2023), gift cards (Lashgari et al., 2024), and opportunities to save money (Miao et al., 2023).

2.2. Social norms

Social norms are a strong predictor of recycling behavior, as individuals often feel compelled to align their actions with their peers' expectations (Sorkun, 2018). This type of motivation suggests that individuals are driven to recycle not solely for personal gain but also to align with the expectations of their peers. This fits with the mechanism of general reciprocity and cooperation among individuals within a community or social group. When recycling is perceived as a socially accepted or encouraged behavior within a community, individuals feel a sense of obligation to conform to those norms. This conformity can yield benefits, such as social approval, or impose penalties, such as social disapproval for failing to recycle. In communities that actively encourage recycling, social norms reinforce this reciprocal behavior. It is then based on the principle of “paying it forward”—individuals contribute to the collective well-being of the group, and trust that others will reciprocate, and contributions will be returned in some form in the future, even if not directly from the same person (Wittek and Bekkers, 2015; Michael et al., 2020). Those motivated by general reciprocity engage in recycling in the belief that their actions will benefit the environment and the community at large.

Research has found that recycling behavior is driven by observations of others' (recycling) behavior (Tong et al., 2018), expectations that others will also recycle, and the desire to avoid feelings of guilt by recycling (Lee et al., 2019). In addition, community-driven interventions and shared values that align with take-back programs play a significant role in promoting participation (Helmefalk et al., 2023). Individuals who are committed to environmental causes understand the long-term value of their participation even without direct compensation. They are driven by a sense of social responsibility and trust in the mutual benefits of collective action.

2.3. Altruism

Research has shown that altruism plays a crucial role in recycling and other environmentally friendly actions. Kalinowski et al. (2006) found that individuals are more inclined to engage in recycling behavior when they have a deeper commitment based on altruistic values rather than self-interest. Altruism is the act of helping driven by a selfless concern or a desire to benefit others without the expectation of any form of personal gain or return. It is defined as a “voluntary behavior intended to benefit another, which is not performed with the expectation of receiving external rewards or avoiding externally produced aversive stimuli or punishments” (Eisenberg and Miller, 1987, p. 92). According to Bar-Tal (1986, p. 5), the majority of scholars generally agree that altruistic behavior must fulfill five criteria: " (a) (...) benefit another

person, (b) (...) be performed voluntarily, (c) (...) be performed intentionally, (d) the benefit must be the goal by itself, and (e) (...) be performed without expecting any external reward.” Altruism stands in contrast to “self-interests” (Lay and Hoppmann, 2015), as it does not include the expectation of social exchange inherent in the motivational types of direct personal benefits and social norms.

The explained motive behind altruistic behavior differs. Some scholars argue that the benefit of helping the person in need serves as a goal in itself. Here, the behavior arises from a genuine concern about improving others’ welfare and reflects a willingness to sacrifice for others’ benefit, sometimes at a cost to the helper (Pfattheicher et al., 2022; Carlo and Randall, 2002; Harris, 1967). In contrast, others argue that the helper gains internal rewards: “Individuals behave altruistically to reward themselves or self-reward” (Bar-Tal, 1986, p. 6). Consequently, by helping others, we help ourselves. These two distinctions give rise to intrinsic motivations rooted in a genuine and unconditional desire to help others, and to intrinsic motivations driven by the pursuit of a “warm glow,” which encompasses feelings of recognition and personal satisfaction (Wittek and Bekkers, 2015). These intrinsic motivations are inherently interesting, fulfilling, or enjoyable, and stem from the individual’s natural curiosity or passion.

Participation in recycling can create positive emotions because it alleviates the negative feelings associated with waste and responds to the desire to contribute to environmental protection and support the greater good (Sun and Trudel, 2017). Extant research has emphasized the significance of ethical and moral values in shaping recycling behavior (Packard and Schultz, 2024). Individuals motivated by altruism often participate in recycling because they believe it is the right thing to do, and they are driven by a desire to avoid guilt and ensure a better future for others. In addition, nostalgia has been shown to enhance people’s intentions to recycle by providing a sense of meaning (Zhang et al., 2021). Furthermore, Öztürk and Şahin (2023) found that the “warm glow of giving” not only directly influences recycling behavior but also mediates the relationship between altruism and recycling. This suggests that the emotional rewards that people experience, such as witnessing the gratitude of recipients, act as significant motivators for their actions. Understanding these motivators can inform messaging and initiatives that appeal to individuals’ sense of responsibility by framing recycling as a crucial moral duty rather than merely a transactional activity.

Table 1 provides examples and descriptions of these three types of motivation that span the spectrum from selfless altruism to more selfish

Table 1
Motivation types.

		Description	Examples
<i>Intrinsic</i>	Altruism	A desire to benefit others without any expectation of personal gain or reward (selfless concern for others).	<ul style="list-style-type: none"> • Blood donation • Community clean-up • Donating to charities
<i>Extrinsic</i>	Social norms	A desire to conform to community standards driven by the pursuit of social approval, a sense of obligation, and alignment with shared values. Helping without expecting immediate reciprocation but trusting that others will return the favor in the future.	<ul style="list-style-type: none"> • Providing favors to friends and family • Political activism • Giving birthday gifts to each other
	Direct personal benefits	An exchange between the same individuals in which something is traded or given with the expectation that something of equal value will be returned within a specific period (“tit for tat”).	<ul style="list-style-type: none"> • Expecting immediate benefits from an activity • Receiving financial rewards

direct personal benefits. In the following, we scrutinize the roles of these forms of motivation among pen users in the case of Novo Nordisk’s take-back program.

2.4. Inconvenience

Despite the various motivations that may drive recycling intentions, individuals often face personal costs that can hinder their actual participation. Research on participation in take-back programs has identified several barriers that prevent individuals from acting on their recycling intentions. One is the *time required* to engage in recycling. Understanding a new system, sorting recyclables, transporting the products to the collection point, and participating in community programs can be time consuming. This perceived cost can deter individuals from following through on their intentions, even if they recognize the environmental benefits of recycling (Halvorsen, 2008). *Physical challenges* also play a significant role. Long distances to collection points or insufficient space at home for storing used products can hinder participation (Sorkun, 2018). In addition, *inadequate knowledge* and *ineffective communication* pose significant challenges. A *lack of awareness* and *insufficient information* about the purpose and practices of the take-back program are critical barriers, as they limit individuals’ understanding (Kant Hvass and Pedersen, 2019; Botelho et al., 2016). A study by Ehrhart et al. (2020) found that many consumers were unaware of a newly introduced take-back system for used drug disposal, which significantly affected participation rates. Moreover, *inappropriate rewards* can undermine the effect. In this regard, some studies have highlighted the use of financial rewards to increase participation (McKie et al., 2023), while others have found that financial incentives are ineffective (e.g., when consumers are rewarded with a discount voucher) (Li et al., 2021; Kant Hvass and Pedersen, 2019). Lastly, Moussaoui et al. (2022) noted that unpleasant *smells* present another barrier to recycling participation. The above studies underscore the various forms of inconvenience that can keep individuals from recycling. If the recycling process is perceived as cumbersome or difficult, individuals may be less likely to act on their recycling intentions.

The Returpen™ take-back system can be viewed as placing an extra burden on pen users. First, users had to collect and store the used pens in their homes after they came into contact with human bodies and blood. This could introduce some odors as well as the inconvenience of keeping used pens at home. In addition, users needed enough space to keep unused and used pens separate. They might have needed to store the used pens for a month or more before they had an opportunity to deliver them to the collection point. Moreover, users had to spend additional time and energy on returning the used pens either to the pharmacy or by postal mail. In addition, many users were rather old, had other illnesses, faced mobility issues, or preferred to hide their use of the pens because of the stigmatization surrounding them.

Given these conditions, a key issue was whether pen users’ motivations were strong enough to overcome the extra hassle and inconvenience of returning the used pens. In other words, did the extra inconvenience of returning the pens affect the intended recycling behavior of the pen users? What type of recycling motivation was strongest (altruistic, social norms, or direct personal benefits)? In the following, we use the results of the two surveys to answer these questions.

Thus, our central research question is the following: To what extent do intentions to engage in recycling behavior translate into actual participation in recycling when participation entails significant inconvenience? While individuals may express a strong desire to engage in recycling, factors like the extra effort required, unclear instructions, or the absence of tangible benefits may create an intention-behavior gap. Understanding the barriers and inconveniences that inhibit individuals from acting on their recycling intentions is essential for developing strategies for bridging this gap. Identifying those challenges can help design more effective interventions that promote recycling behavior

and, ultimately, contribute to more sustainable practices in society.

3. The case of returpen and pencycle

Every year, Novo Nordisk produces more than 600 million injection pens, which are used all over the world by people with diabetes or obesity. At end of use, the used injection pens, which consisted of plastic (the main part), metal (the needle), and glass, typically ended up in landfills or were sent to incinerators. Although made from high-quality materials, these pens had an exceptionally short lifespan. In response to the large amount of waste from used pens, Novo Nordisk committed to introducing a take-back program for used pens to divert waste from landfills, prolong material life, and pioneer the recycling of medical waste at a scale. The ambition was to separate the basic materials (i.e., plastic, metal, and glass) and use them to produce goods that did not have the same requirements for raw-material cleanliness as the healthcare industry. For instance, they might be used in the production of plastic chairs or similar products.

The take-back program was first launched as a pilot project on December 1, 2020, in three Danish municipalities: Copenhagen, Aarhus, and Kolding (the first, second, and seventh largest cities in the country). Together, these cities together covered approximately half of Denmark's population. The aim was to gain experience (i.e., proof of concept) in collecting used, disposable injection pens from users.¹

Later, the take-back program was expanded to several other countries, including the United Kingdom, which was the first country to launch the program after Denmark. In the UK, the program was named PenCycle (see www.pen-cycle.co.uk/). PenCycle was first introduced as a pilot project in November 2021 in the areas of Glasgow and Clyde, Greater Manchester, and Leicestershire and Rutland to obtain proof of concept. The take-back programs in Denmark and the UK differed slightly due to institutional variations and the different roles of Novo Nordisk in the two markets. In particular, the company's market power and recognition were greater in the home country of Denmark than in the UK.

In Denmark, all relevant organizations, including pharmacies, doctors, diabetes associations, and municipalities, were aligned in support of the take-back program. Pen users were informed of the initiative through communication campaigns on social media, e-mails, posters, and flyers at their local pharmacies, as well as in newsletters from different associations (e.g., pharmacy and diabetes associations), which encouraged them to return their used pens.

The traditional collect-use-disposal routine in Denmark was as follows. Most (97%) pen users picked up their injection pens at their local pharmacies, used them, and then threw them into the trash, after which the pens were sent to incinerators or landfills. The Returpen take-back system changed this routine, as users were urged to return the pens to the pharmacies in return bags specially designed for this purpose. When pen users picked up their injection pens at the pharmacy, they received a return bag. After the pens were used, they collected and stored them at home in the return bag (see Fig. 1), which they brought back to the pharmacy on their next visit. In this way, the pharmacies acted as collection points for the used injection pens. Users typically had to visit their pharmacies frequently anyway to obtain their new injection pens.

In the UK, less than half (47%) of users obtained their injection pens from pharmacies. Most users obtained their pens through other means, such as home delivery, hospitals, and doctors. Moreover, pharmacies were more profit based in the UK than in Denmark. Therefore, the UK take-back program (PenCycle) used another collection model—a postal solution for the return bags. All pen users received a return bag with their new injection pens regardless of whether they ordered their pens from the pharmacy or online. They could then collect and store the used



Fig. 1. Bag for collection and return of used pens.

Source: <https://www.mitliv.dk/artikler-og-vejledninger/returpen>

pens at home. When they had accumulated enough of the used pens in the return bag (typically 12), they mailed it to a central collection point using the prepaid envelope.

This take-back program is particularly relevant for investigating recycling behavior in the healthcare sector for several reasons. First, it serves as a real-world example, thereby allowing researchers to observe actual behaviors and practices, rather than just intentions. Second, the program's reliance on voluntary participation without tangible incentives offers a unique context for exploring the underlying motivations and barriers that influence recycling behavior. Third, its implementation in both Denmark and the UK facilitates comparative studies across countries. The difference in the collection model between the Danish and the UK take-back programs allows us to study whether the collection model has any impact on the intended and actual recycling behavior.

4. Data collection and method

We collected the data using surveys and in-depth interviews. We also had data on the actual pen-collection rate. Quantitative surveys investigating pen users' motivations for participating in the program were sent to pen users in Denmark in March 2021, and the UK in February 2022 (see Fig. 2). To delve deeper into the reasons for participation and elaborate on the findings, we also conducted 23 in-depth interviews with Danish pen users at the same time as the Danish survey was distributed. Each interview was conducted online (due to pandemic-related restrictions in 2021) with voluntary participants randomly selected by a third-party company. Each of the interviews lasted an average of approximately 1 h. Of the respondents, 15 were from Copenhagen, 6 were from Aarhus, and 2 were from Kolding. They included 11 men and 12 women between the ages of 21 and 76.

In Denmark, the survey questionnaire was sent by e-mail through the Danish Diabetes Association to all 3309 of its members in the three municipalities of Aarhus, Copenhagen, and Kolding. The questionnaire had been pre-tested with the Danish Pharmacy Association, the Diabetes Association, Type 1 Think Tank and Novo Nordisk to ensure the correct use of wording. It was divided into five areas: *demographics*, *motivation to participate*, *information* on the Returpen program, *handling* of the participation process, and *future participation*.

We received a total of 597 responses. Of the respondents, 13% did not use injection pens at the time of the survey. However, as people can

¹ For a more detailed description of the program's design, see Mallick et al. (2022) and www.returpen.dk.

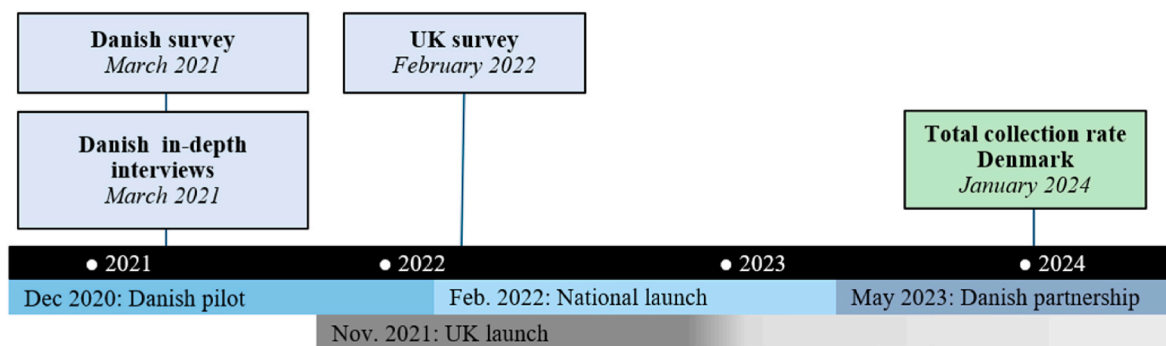


Fig. 2. Overview of data-collection process.

switch among injection types, we included their answers in our analysis.

The basic demographic characteristics of the Danish respondents are presented in Table 2. The gender distribution was relatively even, with a slightly higher share of men (54%). In terms of diabetes type, the split was also rather even: 44.5% had Type 1 diabetes, 53.5% had Type 2, and 2% had another type. Type 1 typically requires more injections and use of injection pens than Type 2. Of the respondents, 60% used 1 to 5 injection pens per month, while only 9% used more than 10 pens per month. Regarding age, 72% of the respondents were 55 or older, and the median age was 64. Almost all the respondents obtained their pens from the pharmacy (97%), and most users went to the pharmacy once per month (39%) or less (49%) to pick up their pens.

Table 2
Demographic characteristics, respondents in the Danish survey (N = 597).

Gender		Diabetes type	
Male	54%	Type 1	44.5%
Female	46%	Type 2	53.5%
		Other	2%
Municipality		Pick-up location for new injection pens	
Kolding	13%	Pharmacy	97%
Aarhus	41.5%	Hospital	0%
Copenhagen	45.5%	Other	3%
Age		Monthly pen usage	
Under 18	1.5%	0	13%
18-24	1.5%	1-5	60%
25-34	5.0%	6-10	18%
35-44	7.5%	11-15	4%
45-54	12.5%	16-20	2%
55-64	24.5%	21-25	1%
65-74	30.0%	26+	2%
75-84	16.5%		
85 or older	1.0%		
How often do you go to the pharmacy?			
More than once per week	0.6%		
Once per week	0.8%		
Every second week	2.2%		
Every third week	8.5%		
Once per month	39.0%		
Less than once per month	48.9%		

A year after the introduction of the Danish pilot, the take-back program was launched in the UK. Four months into their pilot project a survey using the same questionnaire was conducted in February and March 2022 to investigate users' willingness to participate in the program. It was distributed to pen users by e-mail in the three areas of Glasgow and Clyde, Greater Manchester, and Leicestershire and Rutland² through the third-party company "Branding Science." We received a total of 202 responses.

The demographics for the UK respondents were similar to those of the Danish respondents, although there were some variations (see Table 3). The share of UK respondents with Type 2 diabetes was higher (62% in the UK; 54% in Denmark) and they used more injection pens, with medians of seven and four pens used per month in the UK and Denmark, respectively. Notably, pen users in the UK were younger, with a median age of 42 (64 in Denmark) and the median number of years that the users had received this treatment was 8 years.

Table 3
Demographic characteristics, respondents in the UK survey (N = 202)***.

Gender		Diabetes type	
Male	57.5%	Type 1	38.2%
Female	42.5%	Type 2	61.8%
Municipality		Pick-up location for new injection pens	
Glasgow and Clyde	20.8%	Pharmacy	45.0%
Greater Manchester	63.4%	Hospital	9.3%
Leicestershire and Rutland	15.8%	Home delivery	26.9%
		Doctor	15.0%
Age		My caretaker collects	3.8%
18-24	8.4%		
25-34	23.3%	Monthly pen usage	
35-44	26.2%	1-4	26.5%
45-54	15.8%	5-8	26.4%
55-64	9.4%	9-12	12.6%
65-74	12.9%	13-16	19.2%
75-84	3.5%	17-20	9.3%
85 or older	0.5%	20+	6.0%

² Novo Nordisk did choose to conduct the pilot studies in these three municipalities after consulting with several stakeholders including the Danish and UK Diabetes Association. The cities were chosen due to their high population density, diverse population composition, and assumed greater environmental awareness, making them ideal for testing the take-back program, as they provide a broad representation of potential participants and challenges.

5. Results

5.1. Positive attitude

We were unable to measure actual participation on the individual level, as the surveys were conducted in the pilot phases when the system was not yet fully functional with individual routines of returning the pens. In the Danish survey, only 37% of respondents had been offered a return bag at the time of the survey. However, we were able to measure the actual behavior on a more aggregate level at a later stage after the take-back system was implemented. We discuss these more aggregated return-rate measures after the following discussion of the survey results. At this point, we note the existence of a difference between intentions and actual behavior (i.e., an intention-behavior gap).

The overall results from the questionnaire showed a positive attitude towards the take-back system. Of the Danish pen users, 94% felt that ReturnPen™ was a good idea, and 92% wanted to participate. The UK pen users expressed similar support for the take-back program, with 97% indicating it was a good idea.

We also captured respondents' motivations. To assess respondents' recycling intentions, we used extant scales and items. Many of the questions were based on Falk et al. (2023), who offer validated measures of different economic preferences, including altruism, social norms (general reciprocity), and direct personal benefits (direct reciprocity) "in a reliable, parsimonious, and cost-effective way" (p. 24). The constructs and items for the three forms of motivations are listed below:

- Altruism
 - o It is the right thing to do.
 - o It is good that the pens are recycled and go to a good cause.
 - o It is personally satisfying to return the pens.
- Social norms (general reciprocity)
 - o I know others do the same.
 - o It is a benefit to everyone if the pens are recycled.
 - o I expect recycling the pens will also benefit me in the long run.
- Direct personal benefits (direct reciprocity)
 - o I expect some kind of reward for returning the pens.
 - o Returning the pens gives prestige.

These items were included in both the Danish and the UK surveys. Respondents were asked "Why do you want to return your used pens?" and then asked to choose from among the items. They were allowed to select more than one item, as their intentions might not fit into a single category. We then calculated how often each item was indicated as a share of all responses in the two countries. The distribution of the responses is presented in Table 4.

The pattern is somewhat similar in the two countries, as the majority of responses indicated altruistic motivations for returning the pens (73%

Table 4
Distribution of responses on recycling intentions.

	Denmark	UK
Altruism		
• It is the right thing to do.	33.7%	25.3%
• It is good that the pens are recycled and go to a good cause.	26.6%	22.6%
• It is personally satisfying to return the pens.	13.0%	11.9%
	73.3%	59.8%
General reciprocity		
• I know others do the same.	0.5%	3.2%
• It is a benefit to everyone if the pens are recycled.	19.6%	21.4%
• I expect recycling the pens will also benefit me in the long run.	5.3%	9.4%
	25.4%	34.0%
Direct reciprocity:		
• I expect some kind of reward for returning the pens.	0.9%	3.4%
• Returning the pens gives prestige.	0.4%	2.8%
	1.3%	6.2%

in Denmark and 60% in the UK). This motivation was strongly reflected in the two items: "It is the right thing to do" and "It is good that the pens are recycled and go to a good cause," expressing a desire to benefit others and society without expecting a personal gain. The social norms were chosen by 25% of respondents in Denmark and 34% in the UK. In this category, the item "It is a benefit to everyone if the pens are recycled" was chosen by the most respondents. Direct personal benefits and more calculative reciprocity were only selected by 1% of Danish respondents and 6% of respondents from the UK.

All in all, users exhibited strong intentions to engage in recycling behavior driven by altruism and social norms. Notably, when asked whether they expected to use ReturnPen to return the used pens in the future, 83% of Danish respondents answered "yes." Pen return rates were available only for Denmark, while the UK data consisted solely of survey responses.

However, when digging deeper into the survey data and undertaking cross-tabulations with some of the structural variables shown in Tables 2 and 3, we uncover some notable findings. For instance, not all pen users had the same strong motivations for recycling. Table 5 presents the responses on recycling motivations cross-tabulated with age groups for both countries.³ The share of altruistic respondents increased with age in both Denmark and the UK and was highest for respondents older than 65 (77% in the Danish survey and 64% in the UK survey). So, although the level varies a bit, it is notable that the pattern of motivations is very similar in Denmark and the UK, indicating that we are catching more fundamental human motivations that cut across the two countries.

Statements made during the Danish in-depth interviews and in the survey highlight some of the rationales for the responses. The strong positive response to the take-back system resulted from *altruistic motivations* driven by a mix of environmental concerns and established habits, especially among older respondents. A typical response was:

I think it is good for the environment somehow because normally you would just throw them in the trash. (Interview respondent 19)

A common response from those who were older than 65 that reflects altruistic motivations was:

It is not new for me to return my [used] pens. I have done so for a long time, partly out of concern for drug residues in the environment and now also for the sake of recycling. (Survey respondent 98)

Another notable result was that Type 1 users, who used the most injection pens, generally indicated stronger altruistic intentions than Type 2 users:

Table 5
Recycling motivations by country and age.

	Denmark - Age			The UK - Age		
	Young	Middle aged	Over 65	Young	Middle age	Over 65
	<35	35-65	>65	<35	35-65	>65
Altruism	70%	74%	77%	48%	58%	64%
General reciprocity	28%	25%	22%	35%	34%	32%
Direct reciprocity	2%	1%	1%	17%	8%	4%

³ The table presents the cross-tabulations, while a regression analysis that included all structural variables were conducted. It provided very similar results, with mainly age and type of diabetes determining the type of recycling behavior both in Denmark and the UK.

It seems super smart if you can reuse some of it. (...) It requires very little effort compared to how well it can be reused. (...) It is really just mostly a habit. (Interview respondent 6)

Social norms served as a motivating factor, as they cultivated a sense of collective responsibility, normalized recycling behavior, and encouraged individuals to view their participation as a valuable contribution to society.

It is a bit more of a hassle than just throwing the pen away but it is fine. I feel that what we, as a society, gain from returning the pens outweighs the slight inconvenience. (Survey respondent 128)

It is simply the best initiative—something you would not have thought of, even though recycling and collection have become a big part of society nowadays. (Survey respondent 125)

In contrast, the *direct personal benefits* motivation was highest among the youngest respondents, especially young pen users from the UK, where the proportion of respondents selecting this response was 17%. The following statement expresses a common view among the younger pen users (less than 35), who seemed to think more along the lines of “What is in it for me?” and be concerned about others’ negative perceptions of their behavior:

If the program becomes extensive, it should result in a discount for those who return the pens, as there must be some savings for the manufacturer. (Survey respondent 570)

5.2. Barriers of inconvenience

While respondents’ attitudes were generally positive, the interviews indicated that some pen users viewed the need to collect and return of the pens as an inconvenience. Some respondents noted that a lack of storage space for used pens at home posed a significant challenge, especially among those who used a high number of pens and did not visit the pharmacy regularly. In fact, 86% of Danish respondents visited the pharmacy—the designated drop-off point—once per month or less. Of these respondents, 60% reported using 1 to 5 pens per month, while 18% used 6 to 10. This indicates that many pen users accumulated a significant number of pens before returning them, highlighting the challenge of finding adequate storage space for used pens at home. The following statements highlight this issue:

I do not like having used pens lying around at home, so I throw them out immediately. (Survey respondent 361)

[You have to find] space for many used pens and used needles when you, like me, are not at the pharmacy very often (I buy medicine, including insulin, to cover many weeks at a time). (Survey respondent 600)

One respondent who used a high number of injection pens each month expressed a negative feeling about the perception of being judged by others when returning the pens to the pharmacy. This highlights concerns related to social norms and behavior, especially as living with diabetes is already burdensome for many individuals. The following quote reflects a common concern about participating and suggests that some pen users viewed the recycling system as an additional inconvenience:

I only recently heard about it [Returpen] a week and a half ago after my partner was at the pharmacy and saw a flyer. The first thing I thought was “I do not want to bother with that.” (...) I think I would look a bit if I saw someone come in with a bunch of pens in a bag and throw them on the counter. What would be easiest for me would be to throw [my used pens] in an envelope [and send them by mail]. (Interview respondent 2)

The Danish respondents were asked whether their decision to return

their used pens depended on knowing what happened to the pens after returning them. A large percentage (78%) responded that they did not care about the exact use of the returned materials from the returned pens, but that their recycling did matter:

It is just important to know that what is being recycled does not just end up in some waste bin. (Interview respondent 9)

Among UK respondents, 37% shared the same view, while 38% expressed a desire to know the specific use of the returned items and 25% were uncertain. The latter figure could indicate a need for greater transparency, a desire to understand the personal impact of their actions, or a lower level of trust in the recycling program. Although the Danish survey reflected high confidence in the responsible use of the materials after the pens were returned, several respondents highlighted a need for more information. This indicates that while there was a strong sense of trust among Danish respondents, there was also a clear desire for more transparency and information:

It would be good to know what the materials are being reused for. Too many high-quality materials end up at the bottom of the scale when they are recycled. Ideally, pens should be made into new pens. (Survey respondent 326)

I would like to know what they are used for. Could you provide information on the (return) bags? (Survey respondent 102)

Notably, 77% of respondents in the UK were unaware of the take-back initiative before completing the survey, while the corresponding figure in Denmark was 59%. This underscored the need to enhance awareness of the program among pen users:

I have been using disposable pens for about 12 months, and it was only recently that a pharmacy clerk asked if I knew about the pen-return program. It could definitely be promoted better if all pharmacies informed customers about it when handing out disposable pens. (Survey respondent 489)

In addition, some respondents highlighted a lack of clarity regarding how the take-back system worked and indicated a desire for more information about the rationale for participating. This sentiment was particularly pronounced when compared to the simpler, plastic-sorting system organized by municipalities, where the used pens were thrown into general waste and usually sent to an incinerator. In this regard, respondents stated:

It is a hassle to have to sort them separately and remember to bring them to the pharmacy. I wish they could go in the regular trash and be sorted out at the municipal facilities. (Survey respondent 370)

I am unsure whether it is only Novo’s pens that can be returned. (Survey respondent 233)

Lastly, returning pens could be time-consuming, as individuals might need to wait in line to drop off the pens. One respondent noted:

It might be easier if a container was available where one could drop off the bags with used pens to avoid waiting and taking the pharmacy staff’s time. (Interview respondent 14)

The findings revealed a strong intent to participate in the take-back program, with people exhibiting different motivations. However, they also underscored various inconveniences associated with participation. This leads to a key question: Did individuals follow through with their intention to participate in ReturpenTM?

5.3. Actual behavior

It was not possible to measure actual behavior at the time of the survey because the take-back program had not yet been fully implemented. In addition, there was a time lag between handing out the return bags and returning used pens. However, in Denmark, we were able

to follow actual pen returns in three different periods (see Table 6). In February 2022, the take-back program was scaled up to the national level. In May 2023, it was expanded to include four other healthcare companies and their products.

From December 2020 to January 2024, the return rate was remarkably stable at around 22%. This implies that 22% of the single-use injection pens sold to pen users in Denmark were returned through the program. As this is a healthcare product, it is difficult to compare this return rate to return rates for other products. However, despite the lack of tangible incentives and the significant inconvenience associated with returning the used pens, the stable return rate over time could indicate that the already participating end-users found the take-back system satisfactory, driven by altruistic and social-norm motivations. The stability in the return rate over the 3 years also indicates that it seems to be difficult to significantly change individual behavior and increase the return rate without stronger incentives. Or put differently, you can get some way based on the altruistic and social-norm motivations, but that alone will not make all the good intentions come true.

It is notable that there is a clear gap between the return rate of 22% and the highly positive intentions that were expressed in the surveys. Such intention-behavior gaps are widely recognized in the extant literature—people often claim in surveys that they will do more good things than they actually do in practice if the focal behavior is somewhat inconvenient (see Kollmuss and Agyeman (2002) for a comprehensive review of the literature on the intention-behavior gap).

6. Discussion

Diabetes is an illness that creates inconvenience for many people, as they have to take extra care of their bodies, their food, and their medicine. The illness is accompanied by many annoying and dangerous side effects. In addition, diabetes is stigmatized. Thus, insulin users are already burdened, making it particularly challenging to set up a take-back program for a healthcare product like injection pens. Despite all of the good intentions, several barriers and inconveniences make it hard to ensure the injection pens will be returned after use.

Our results showed high support for the take-back program and that the high intentions to participate in the program had different motivations—altruism, followed by social norms, and direct personal benefit. The primary motivation of altruism is selflessness and a genuine desire to benefit others with no expectation of personal gain or reward, even if there is a potential personal cost (Carlo and Randall, 2002). As stated by Bar-Tal (1986), altruistic behavior must live up to five criteria to be considered altruistic. It must (a) benefit another person. The results indicate that altruistic motivation increases with age. Some respondents explained this was due to heightened concerns about the environment. These respondents cited concerns about waste reduction and preventing harm from substances like medicine residues. They also emphasized the importance of others' safety, noting the potential risks associated with discarded items. This indicates not only a sense of responsibility and a duty to handle the pens correctly but also a belief that the recycling efforts would be carried out correctly. This, in turn, highlights a trust in authority and a sense of responsibility among pen users, which correlates with respondents answering, "It is the right thing to do." This indicates pure altruism, a behavior motivated by a genuine and unconditional desire to benefit others. As stated by Pfattheicher et al.

Table 6
Pen return rates by program phase in Denmark.

20%	22%	22%
Danish pilot phase	National scaling	Industry pilot
Three municipalities: Copenhagen, Kolding, Aarhus	All 98 municipalities	Expanded with four partners
Period: 13 months Dec. 2020–Jan. 2022	Period: 15 months Feb. 2022–April 2023	Period: 9 months May 2023–Jan. 2024

(2022), the overall goal is to increase others' welfare, which might suggest that benefiting society serves as a goal in itself.

Moreover, the behavior must be performed (b) voluntarily and (c) intentionally. Participation in the take-back program was not a quick "here-and-now" behavior—it took place over an extended period, as individuals had to actively decide to participate, and to expend time and energy on collecting, storing, and returning their used pens despite any inconvenience. The data indicates a consistent participation rate of around 22%, suggesting that individuals made intentional and mindful decisions to engage. In addition, (d) the benefit must be a goal in itself (e) without expectations of an external reward. For some, storing the used pens at home was an obstacle due to a lack of space, especially among those who rarely visited the pharmacy, those who used a high number of pens, and those uncomfortable with storing used medicine at home. This suggests that practical and logistical considerations also influenced individual motivations to participate in the take-back system.

Notably, the results showed that Type 1 diabetics—the group that used the most pens—had stronger altruistic intentions. They commented that participation was not difficult and had become part of their normal routines. As Wittek and Bekkers (2015) argue, engaging in recycling behavior for altruistic reasons can trigger intrinsic stimulation by offering a "warm glow" feeling through recognition or good feelings about oneself. This is also denoted as "impure altruism" in the literature. Thus, helping others can provide a sense of personal fulfillment and satisfaction. This could indicate that people engage in this behavior because they recognize the impact of excessive pen usage on the environment and because participation makes them feel like they are helping to solve a societal issue. Individuals find motivation rooted in altruism by actively participating in initiatives that promote the proper disposal of used pens and contributing to the broader effort to reduce waste. Participants take pride in being part of a movement that seeks to do good for both society and the environment. Such actions may incur a cost for the helper (Carlo and Randall, 2002), like the inconvenience in this case. The motivation to "go the extra mile" and collect, store, and return their used pens at the pharmacy outweighed the inconvenience.

The respondents expressed a desire for more information on the handling of the returned pens. They also requested clearer statement on why the normal municipality waste-sorting system could not be used as well as access to information at the pharmacy, which served as the connection point between pen users and the take-back program. However, respondents also indicated that they did not need details on what happened to the pens after they were returned. Instead, their primary concern revolved around being assured that the pens were recycled and that their participation in the process mattered. This suggests a reciprocal expectation: "If I return my pens, I trust that they will be handled correctly." One-fourth of the respondents were motivated by social-norms reciprocity—these individuals trusted that others would return the favor. Thus, the focus was on the overall balance of giving and receiving within a community (André, 2010). This could indicate that an absence of such information could affect motivation, as it diminishes the sense of accountability and trust in the recycling process.

Motivations related to direct personal benefits were highest among the youngest respondents, who worried about what other people might think when they return their used pens to the pharmacy. This was particularly true among those with high pen usage. This suggests that respondents who used many pens were self-conscious about their pen usage, which they typically did not want to display to others by returning a large number of used pens. This could indicate a fear of negative social judgment or standing out from the crowd. The direct personal benefits motivation involves the principle of "tit for tat," where something is traded with the anticipation that something of equal value will be returned within a short timeframe. Therefore, the potential for embarrassment may necessitate a more present and direct motivation to encourage participation.

Lastly, when comparing participation rates, we found a discrepancy between the high intention to participate (above 90%) and the actual

return rate of approximately 22%. This confirms the existence of an intention-behavior gap. In addition, we know that living with diabetes is inconvenient for many pen users. In such situations, a take-back system may be considered an extra burden. Barriers (e.g., feelings of embarrassment) and practical difficulties or concerns might outweigh the perceived benefits of participation. Due to these barriers or constraints in the real-world context, the intentions expressed in the surveys might not translate into action. This could suggest that even if participation intention is high, the obstacles mentioned by the respondents should always be prioritized, as they can significantly impact actual participation.

While there was a strong sense of trust among the Danish respondents regarding the responsible handling of materials after returning the pens, there was also clear demand for more transparency and information. Specifically, respondents expressed a desire to understand the use-case of the recycled materials. Providing details such as the amount of materials collected, emissions saved, or how the recycled materials are utilized in new products could significantly enhance user trust and engagement. Transparent communication of these outcomes would instill a sense of purpose and convey that participation truly makes a difference.

7. Conclusion

Altruism is a primary motivator for participation in take-back programs, especially among middle-aged and older individuals. This motivation is rooted in environmental awareness and a sense of responsibility. Social norms—seeking assurance that participation will have an impact—are evident across demographics, emphasizing a desire for community balance. Conversely, direct personal benefits play a minor role, although this motivation is slightly more important among younger participants driven by a desire for immediate returns or recognition.

Our investigation of the drivers of pen users' participation in Novo Nordisk's take-back program reveals a multifaceted motivation landscape. The results from both our Danish and UK analyses indicated widespread support for the take-back program and strong intentions to participate. They also showed that environmental concerns and a desire to ensure the correct disposal and handling of used pens were the primary drivers of support for the program. Our analysis also revealed that intention to participate was largely motivated by altruism, followed by social norms. Altruistic motives, particularly prevalent among older individuals, stemmed from a sense of responsibility for waste reduction and trust in proper recycling efforts. Social norms manifested as a desire for assurance that participation mattered, without participants necessarily wanting to know the specific end uses of the returned pens. In this regard, information about the handling process promotes social norms, as the focus lies on the overall balance of giving and receiving within the community. Direct personal benefits—the least important motivation—were primarily a motivator among younger respondents, which is explained by their desire for immediate returns and their adoption of tit-for-tat principles. This group was concerned about the embarrassment of participating in the program.

The observed intention-behavior gap in which the actual return rate differed from expressed intentions underscores the difficulty of motivating individuals to act on their intentions. Nevertheless, the steady participation rate of approximately 22% suggests resilience in participants' commitment. This persistence highlights the value placed on the program's objectives and indicates a strong underlying motivation to participate. In essence, the program's success lies not only in addressing environmental concerns but also in understanding and harnessing the various motivations that drive recycling behavior among pen users. Recognition of the diversity among end users and applying different motivational strategies can help foster engagement in recycling programs. Future research could expand on these findings by exploring various motivational nudges designed to promote recycling as a social

norm or appeal to altruistic incentives. Given that individuals are motivated by diverse factors, investigations of the combined effects of multiple nudges on end users' recycling behavior could yield valuable insights into methods of enhancing participation rates. By examining how different nudges interact, researchers can better understand their collective impact on fostering a recycling culture in the healthcare sector.

CRedit authorship contribution statement

Cecilie Wagner Harden: Writing – original draft, Project administration, Methodology, Data curation, Conceptualization. **Torben Pedersen:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Peter D. Ørberg Jensen:** Writing – review & editing.

Declaration of competing interest

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Data availability

The authors do not have permission to share data.

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