

T.C.
REPUBLIC OF TURKEY
YEDITEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
PHARMACOECONOMICS AND PHARMACOEPIDEMIOLOGY



**AN ECONOMICAL ANALYSIS ON UNUSED AND
WASTED MEDICINES**

MASTER OF SCIENCE THESIS

ESRA ÇELİK, MSc

İstanbul – 2019

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ADVISOR




ASSIST. PROF. DR. NAZLI ŞENCAN

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	Unvanı, Adı-Soyadı (Kurumu)	İmza
Jüri Başkanı:	Prof. Dr. Süle Rabus (Uludağ Univ.)	
Tez danışmanı:	Dr. Öğr. Üyesi Ejale Sencer (Acıbadem Üni.)	
Üye:	Doç. Dr. Hediye Sıfıttı	
Üye:		
Üye:		

ONAY

Bu tez Yeditepe Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğinin ilgili maddeleri uyarınca yukarıdaki jüri tarafından uygun görülmüş ve Enstitü Yönetim Kurulu'nun 28/06/2019... tarih ve 2019/11-01... sayılı kararı ile onaylanmıştır.


Prof. Dr. Bayram YILMAZ
Sağlık Bilimleri Enstitüsü Müdürü

DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

14.07.2019

Esra ÇELİK



DEDICATION

To my little Kerem and to my precious Zeynep.

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I am grateful to the many people who helped me to complete this study with their support, guidance and faith.

First of all I would like to express my gratitude to my family for faith in me, especially to my mom for never abandoning me and my Zeynep Güzel for her support me all the time.

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LIST OF SYMBOLS AND ABBREVIATIONS

API: Active pharmaceutical ingredient

ATC: The Anatomical Therapeutic Chemical

EU: European Union

GDP: Gross Domestic Product

İEİS: Pharmaceutical Manufacturers Association of Turkey

NSAID: Non-Steroidal Anti Inflammatory Drugs

OECD: Organisation for Economic Co-operation and Development

OTC: Over The Counter

PPP: Purchasing Power Parity

SGK: Social Security Institution

STP: Sewage treatment plants

SUT: Health Application Announcement

TL: Turkish Liras

USD: United States Dollars

WHO: World Health Organization

USA: United States of America

YUDIC: Yeditepe University Drug and Poison Consultancy Unit

ABSTRACT

Çelik E. (2019). An Economical Analysis on Unused and Wasted Medicines. Yeditepe University, Institute of Health Sciences Pharmacoeconomics and Pharmacoepidemiology, MSc thesis, Istanbul.

Purpose: Unused/wasted drugs are a growing problem globally. This study was aimed to analyze the economic loss of unwanted/unused pharmaceutical products by an unused drug collection campaign held in a university.

Materials & Method:

The study conducted via Unused Drug Collection Campaign organized on the campus of Yeditepe University in Istanbul, Turkey in 2010. Collected drugs were recorded with price information (in 2010 and 2019 prices both), drug feature (content, expiry date, generic/original status and etc.) and past data needed for analysis. The results were compared by distribution in different features and pricing to make analysis.

Result and Conclusion:

107 participants brought 1230 pharmaceutical products to the campaign for disposal. The economic burden of total products was 8.086 TL for retail pricing and 6.114 TL for SGK in 2010. In 2019, cost of wasted drugs was estimated as 13.526 TL and 8.721 TL respectively. Paracetamol (n=59), ipratropium bromide (n=43) and vitamin combinations (n=24) were found to be the mostly wasted. Tablet (44,63%), capsules (8,86%) and injectable forms (6,26%) predominated as dosage forms. 45,55% of total drugs were original whereas 39,63% of them were generic. Regarding expiration date, drugs were kept 10 months after expiry date as mean. Most of collected drugs were expired (63,04%), with their original container (62,28%) and used (69,94%). 9,83% of the whole drugs were drug samples and 30,06% were never used.

The need for public education and awareness about negative effects of unused drugs in health, economic and also in environment should be emphasized. Further studies should be conducted to evaluate the extend of waste. In addition, health care professionals and particularly pharmacists should encourage the public to learn rational use of drugs and safe

disposal of drugs. The incremental cost of unused/wasted drugs can be minimized by collaboration of governments, educators, health care providers and public.

Key words: Unused drugs, drug waste, burden of drug waste, economic aspect of wasted medicine



ABSTRACT (Turkish)

Çelik E. (2019). Kullanılmayan ve Atık İlaçlar Üzerine Bir Ekonomik Değerlendirme. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Farmakoekonomi ve Farmakoepidemioloji Yüksek Lisans Tezi. İstanbul.

Amaç: Kullanılmayan/atık ilaçlar tüm dünyada git gide büyüyen bir sorundur. Bu çalışma, kullanılmayan ve istenmeyen farmasötik ürünlerin yarattığı ekonomik kaybı bir üniversitede yürütülen bir kullanılmayan ilaç toplama kampanyası üzerinden analiz etmeyi amaçlamaktadır.

Materyal & Metot: Çalışma İstanbul Yeditepe Üniversitesi kampüsü içerisinde gerçekleştirilen Kullanılmayan İlaç Toplama Kampanyası ile başlamıştır. Getirilen ilaçlar; fiyat bilgisi (2010 ve 2019 yılları için), ilaç özellikleri (içerik, son kullanma tarihi, jenerik/original durumu ve benzeri) ve ilaçla ilgili analiz için gerekli geçmiş bilgiler kayıt altına alınmıştır. Sonuçlar, analiz için farklı özelliklerin dağılım ve maliyetinin karşılaştırılarak oluşturulmuştur.

Bulgular ve sonuç: Kampanyaya 107 katılımcı 1230 adet farmasötik ürün getirerek katılmıştır. Bu ilaçların ekonomik maliyeti 2010 yılında perakende fiyatı üzerinden 8.086 TL ve kamu fiyatı üzerinden 6.114 TL. Aynı ilaçların 2019 maliyet analizinde 13.526 TL perakende olarak ve 8.721 TL kamu için atık ilaçlar dolayısı ile israf edildiği görülmüştür. Parasetamol (n=59), ipratropium bromür (n=43) ve vitamin kombinasyonları (n=24) en çok israf edilen ilaçlardır. Tablet (44,63%), kapsül (8,86%) ve enjektabl formlar (6,26%) dozaj formları arasında en çok bulunanlardır. Tüm toplanan ilaçların 45,55%'i original ve 39,63%'ü jeneriktir. Son kullanma tarihi analizinde, ilaçlar evde son kullanma tarihi geçtikten ortalama 10 ay sonrasına kadar evde saklanmaktadır. Toplanan ilaçların büyük çoğunluğunun son kullanma tarihi geçmiş (63,04%), kutulu (62,28%) ve kullanılmıştır (69,94%). Toplananların 9,83%'ü bedelsiz ilaç numunesi ve 30,06%'sı hiç kullanılmamıştır. Halkın, kullanılmayan ilaçların sağlık, ekonomi ve çevre üzerine

negative etkileri hakkında eğitim ve farkındalığına olan ihtiyaç vurgulanmalıdır. İsrafın boyutunu değerlendirebilmek için daha kapsamlı arařtırmalar yapılmalıdır. Ek olarak, sađlık alıřanları ve özellikle eczacılar halkı ilaların akılcı kullanımı ve güvenli imha yöntemlerini öğrenmeleri konusunda teşvik etmelidirler. Kullanılmayan/atık ilaların maliyeti, devlet, eğitimciler, sađlık alıřanları ve toplumun iş birliđi ile en aza indirilebilir.

Anahtar kelimeler: Kullanılmayan ilalar, ila israfı, ila israfının maliyeti, israf edilen ilaların ekonomik boyutu



1. INTRODUCTION

Health is one of the most precious facts of the life. World Health Organization (WHO) defines “health” is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (1). In the communication and internet era, developed treatment options and awareness about well-being expand life span worldwide especially in developed countries.

With global aging and new refractory diseases existence, health expenses increased with chronical conditions of elderly, new serious diseases occurrence and new costly therapy options. Drugs/pharmaceutical products play a vital role in the health system. As related with this, drug expenses have increased in global health expenditures. At the same time, unused and wasted drugs are being enormous condition affecting budget, health and environmental safety. The picture seems very complicated but the tiny bonds make the parts comprehensible.

In this thesis, a pharmacoeconomical analysis of unused and wasted medicine was done. Not just economical aspects, environmental and negative effects on health of unused and wasted drugs was detailed. This is the first study in literature comparing unused/wasted medicines expenses for nine years period.

2. HEALTH AND DRUG EXPENDITURES, UNUSED/WASTED DRUGS AND IRRATIONAL DRUG USE

Globally, people live in a technology era and can reach easily to another part of the world or something, someone via any device with internet connection. While this results in technological innovations and developments, on the other hand, sedentary life-style induces sickness and increase morbidity. There is a close relation between health status of the society and economic development. Giving more attention to individual capital, reserving resource to health more and rising individual awareness related to health are indicators of development. Technological innovations, aging of population, new diseases and their expensive therapies, facilitating access to health and information, evolving preventive therapies and efficient treatment alternatives promote health expenses and significant changes in the overall health system (2,3). Consequently, drug expenses rise in health spending.

2.1. Drug and Health Expenditures

According to the WHO, health systems consist of all the people and actions whose primary purpose is to improve health (4). In consideration of pharmacoeconomical vision, as many as possible number of people must be covered cost-effectively in an efficient health policy. It is very important to make more people reaching the health services and drugs for an effective health system.

Pharmacoeconomical costs can be grouped as direct costs, indirect costs, and intangible costs. Drug expenditures, medical examination fees, laboratory tests, diagnostic transaction costs, and the money directly paid by patients and relatives of patients for treatment are expressed as direct costs. Factors such as reduction of a patient's ability to work or early death are counted as indirect costs. Thirdly, factors such as stress and pain, which are difficult to calculate in monetary terms are

intangible costs. Evaluators regarding pharmacoeconomics, take direct costs into account and make assessments (5).

As a direct cost, drug expenditures in the health system is hard to evaluate concept. Countries' national drug policies have to include all key stakeholders such as pharmacists, physicians, pharmaceutical firms, and patients in the public, the private sector, and the field of pharmacy (5). High cost unnecessary drug dispense and extravagant consumption of the sources negatively affects both health economy and economy of the countries. Hence, new arrangements about drug waste should be developed all over the world (6).

2.1.1. Drug and Health Expenditures in the World

As mentioned before, the life span has expanded and the population increase is inevitable. Although the growth rate has decreased, as shown in Table 1, increased world population is reached to nearly 8 billion in March 2019 (7).

Table 1: World Population History⁽⁷⁾

Year	Population	Growth Rate
2019	7.714.576.923	1,07%
2010	6.958.169.159	1,23%
2000	6.145.006.989	1,29%
1990	5.330.943.460	1,72%
1980	4.458.411.534	1,78%

Each country has its own health management strategy to handle health and drug expenditures. As a result of increased population, health expenditures and also, drug costs in it are increasing relatively. Annual growth rate of health expenditure may be floating but the increasing costs is stable. As an example, annual growth of

the health expenditure and Gross Domestic Product (GDP) in Organisation for Economic Co-operation and Development (OECD) Countries for the 2000-2017 period is given below (8).

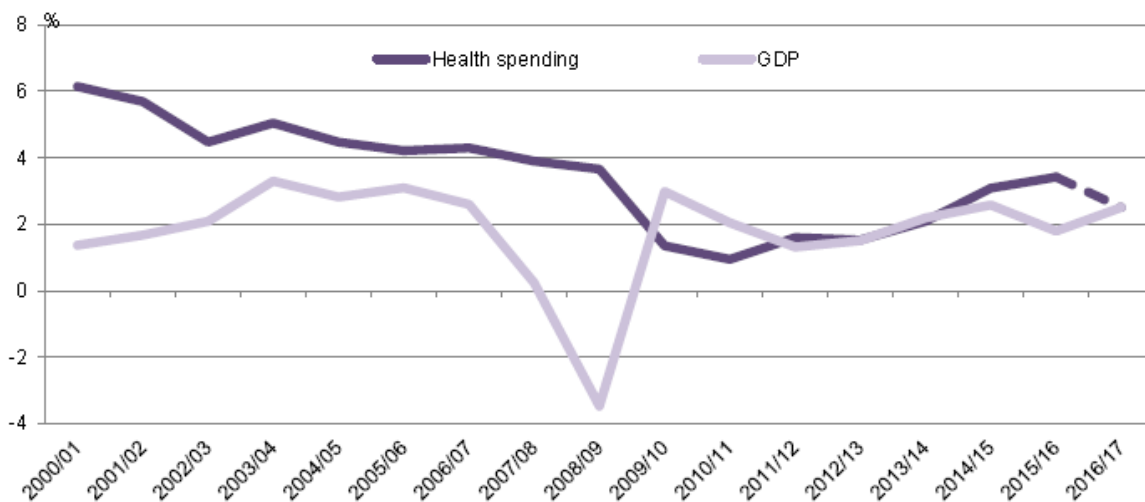


Figure 1: Annual growth of the health expenditure and GDP in OECD Countries in real terms, 2000-17

As seen in the figure, economic crisis and decrease in GDP had not affected health spending distinctive from other important spending. This is a key showing that the fact of health is crucial in humanity. A special point of view is needed to evaluate health economy apart from economies of goods.

Another example, total healthcare expenditure in the United States grew 4.3% in 2016 compared with 2015. Over the same period, this was in contrast to a 2.8% increase in the U.S. GDP. The 3.3 trillion dollars spent on healthcare in 2016 accounted for 17.9% of the total GDP (9). A new analysis from U.S. federal government shows \$3.65 trillion on health care in 2018, according to a report (10).

In recent years, drug expenditures come near to 20% in total healthcare expenses in developed counties like OECD whereas in developing countries, this rate

is changing between 20% and %40. Increase in industrialization and income level result in more funds transferring to healthcare services and thus drug expenses are more than low income countries (6).

According to a report from IQVIA (a nonpartisan health care data analytics firm), “The global pharmaceutical market will exceed \$1,5 trillion by 2023 growing at a 3–6% compound annual growth rate over the next five years. The key drivers of growth will continue to be USA (United States of America) and pharmerging markets with 4–7% and 5–8% compound annual growth, respectively. In the United States, overall spending growth is driven by a range of factors including new product uptake and brand pricing, while it is offset by patent expiries and generics. Medicine spending in Japan totaled \$86 billion in 2018, however spending on medicines is expected to decline by -3 to 0% through 2023, largely because of exchange rates and the continued uptake of generics. In Europe, cost-containment measures and less growth from new products contribute to slower growth of 1–4%, compared to the 4,7% compound annual growth seen over the past five years. Pharmaceutical spending in China reached \$137 billion in 2018 and is expected to reach \$140–170 billion by 2023, but its growth is likely to slow to 3–6%.” (11). The global spending and expectations are summarized in Figure 2 (11).

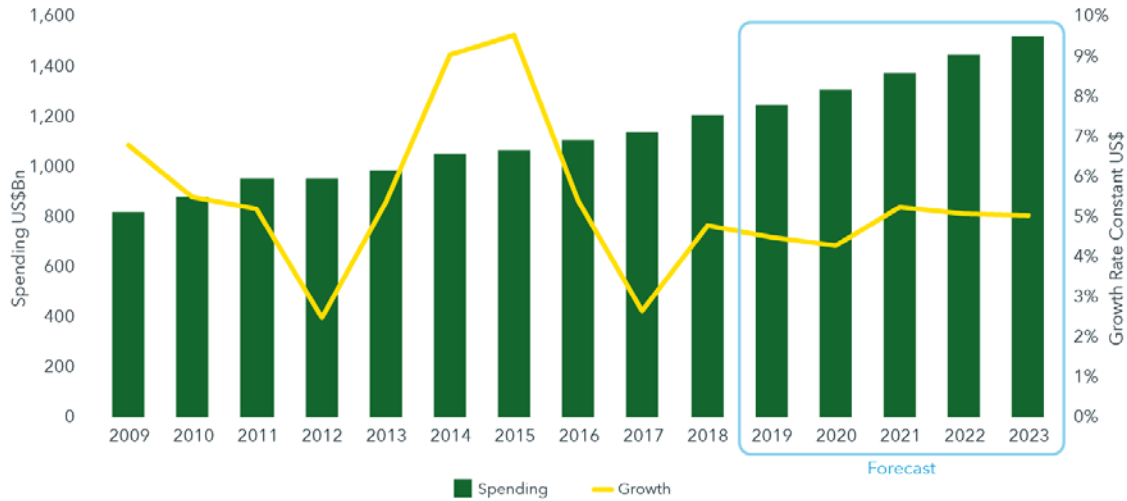
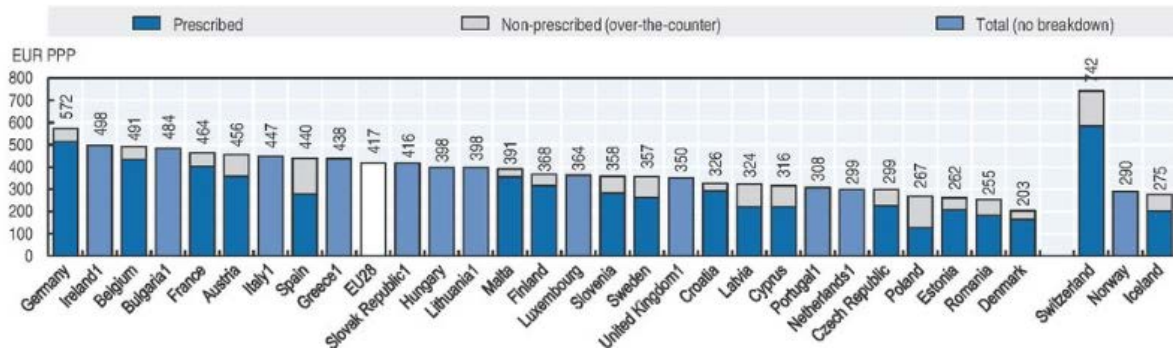


Figure 2: Global Drug Spending and Growth Expectation 2009-2023

Pharmaceuticals should not be thought as prescription only products. Over the counter (OTC) drugs and supplements are widespread in many countries via drugstores. On the other hand, patients can buy most of the medicines (apart from OTC drugs and supplements) easily without a prescription via pharmacies in several countries like Turkey.

In a bulletin from OECD in 2018, the total retail pharmaceutical bill across the European Union (EU) was more than 210 billion euro in 2016 and since 2010, the increase rate is around 5%. In Figure 3, drug spending of countries in OECD can be seen (12).



*PPP is referring Purchasing Power Parity

Figure 3 Expenditure on retail pharmaceuticals per capita in OECD, 2016

Spending on pharmaceuticals is huge so the pharmaceutical market is an everlasting and devastating market. According to data set via IQVIA, drug sales in EU increase by 7,3% while box sales increase was near 0,1% (13). IQVIA reports show sales data from the pharmaceutical warehouses to the pharmacies.

Table 2: Total Sales in EU Counties 2015-2017

Year	Sale (in USD) (Thousands)	Sale (in box) (Thousands)
2015	208.120.609,121	35.936.903,317
2016	212.045.026,051	36.369.246,107
2017	223.314.944,177	36.245.103,976

*USD (United States Dollars)

In the United States, total USA. drug expenditures was found \$307,5 billion (14). With the effect of new treatments releasing to drug market like high cost products biologics and biosimiliars, total prescription sales for the 2017 calendar year rose \$455,9 billion (9).

In this big picture, it is obvious that the drug expenditure is getting greater year by year in all over the world. It's efficient management and prevention from

unnecessary lost (like unused/wasted drug costs) is getting major concern of policy makers.

2.1.2. Drug and Health Expenditures in the Turkey

Like all over the world, aging of population as an indicator of wellness exists in Turkey, too. So chronic disease and their treatments leads in increasing health expenditures. Distribution of the age groups in Turkey is given in Figure 4 (15).

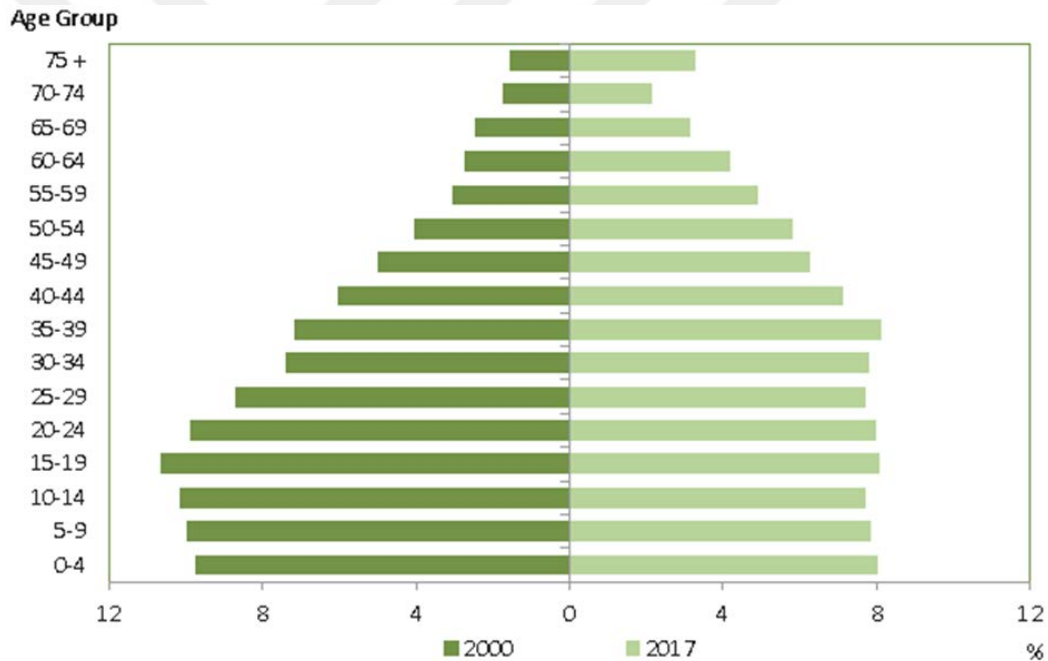


Figure 4:Population Pyramid in %, 2000-2017

Turkey has lower elderly (age 65 and over) rate in comparison to global, EU and high-income group countries. The comparison is shown in Figure 5 (15).

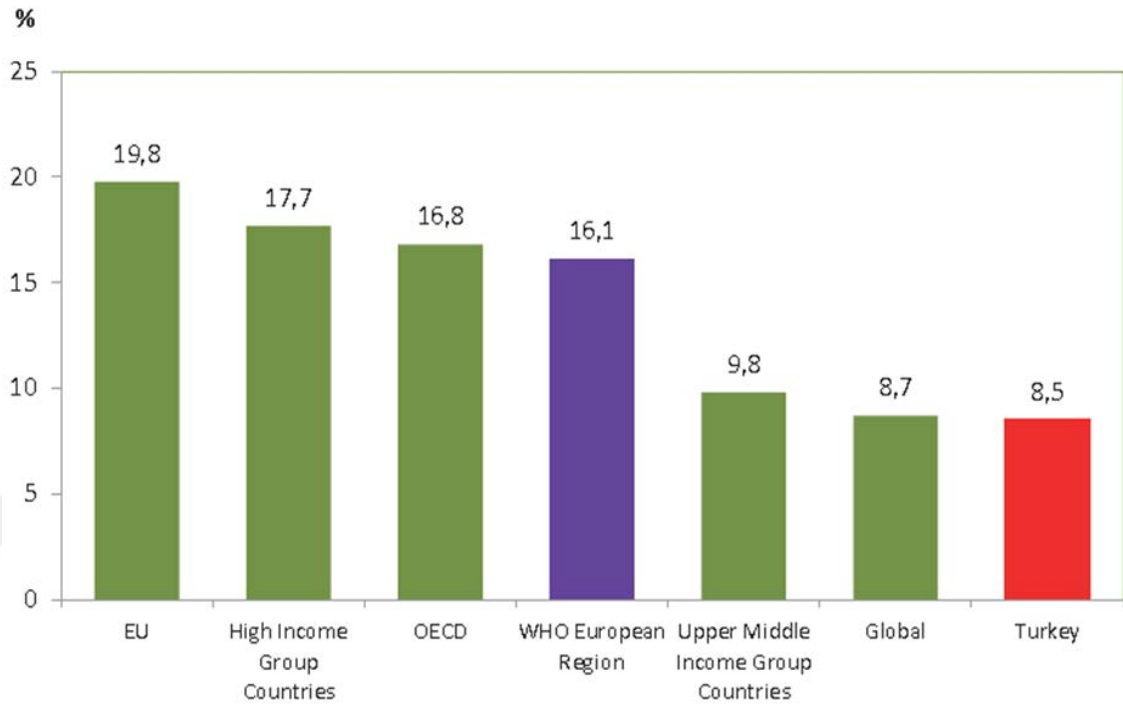


Figure 5: International Comparison of ≥ 65 Aged Population Ratio (%), 2017

According to latest data published by Turkish Statistical Institute, the total health expenditures have risen up to exponentially for 20 years. On the other hand, proportion of the total health expenditure to the GDP was rose until 2009 and decreased until 2017 (16). Total health expenditures in Turkey given in Table 3 based on currency formats of Turkish Liras (TL), US dollars and also PPP US dollars. Besides, it is important to take in consideration depreciation of Turkish Liras in Turkey especially in last 2 years.

Table 3: Total Health Expenditures in Turkey, 2005-2017

Year	Total Health Expenditure (million ₺)	Total Health Expenditure (million \$)	Total Health Expenditure (million PPP \$)	Proportion of Total Health Expenditure to the GDP (%)
2005	35.359	26.236	42.367	5,2
2010	61.678	41.067	67.078	5,3
2015	104.568	38.537	86.951	4,5
2017	140.647	38.551	96.945	4,6

Turkey has the lowest rate in comparison of current health expenditure as a share of GDP between OECD countries as shown in Figure 6. The data of Turkey belongs to the year 2017 whereas countries' data belong to 2016 in this figure (15).

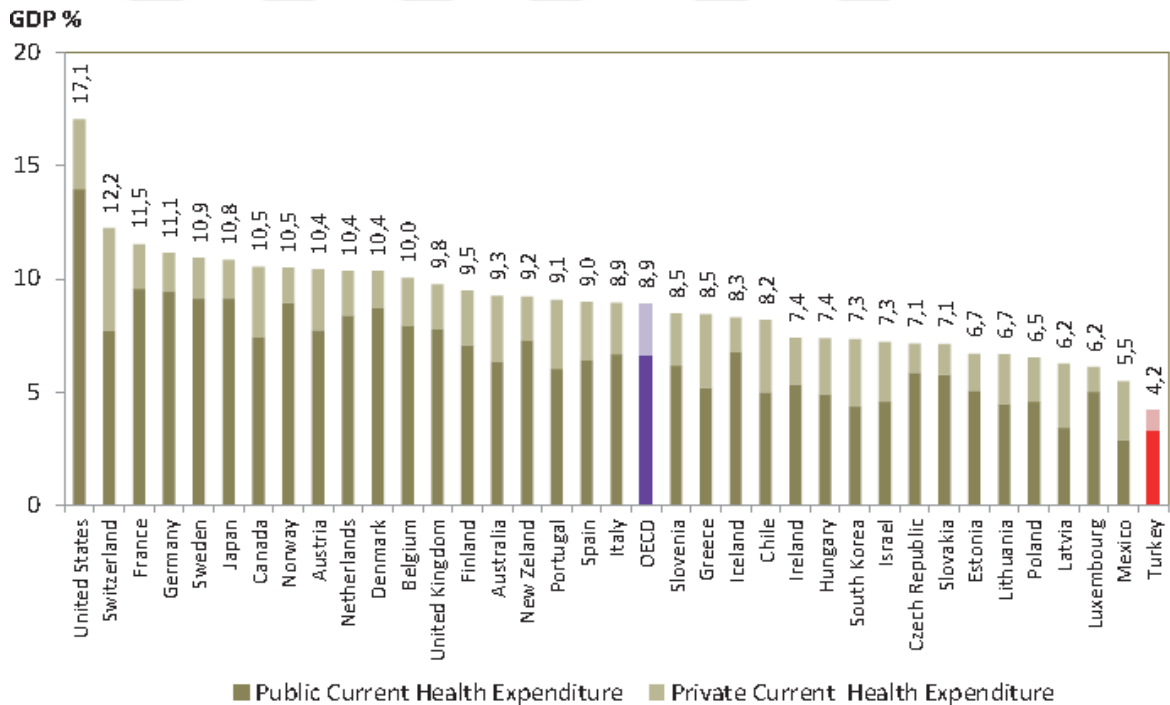


Figure 6: International Comparison of Current Health Expenditure as a Share of GDP, (%), 2016

Public and private health expenses vary in each different country. Every country have to be interpreted in its own system.

Financial structure of the healthcare finance is mixed meaning combining with Social Security System, public expenditure and individual expenses (17). Healthcare services are financed by four resources within scope of General Health Insurance system (18):

- Resources allocated by Social Security Institution (SGK), (with taxes paid by employees and employers),
- Resources allocated from central administrative budget (taxes)
- Out-of-pocket payments,
- Resources allocated by private health insurance organizations (private health insurance premiums).

The principle “universal coverage” is adopted in Turkey and more than 85% of population is covered. Also, limits of the insurance package are determined on a very large basis alike. Principles of coverage package are determined by Health Application Announcement (SUT) and rules written on this announcement determine rules of payments and reimbursements by SGK for every kind of services (18). Financing of the social security foundations has been a macroeconomical problem in Turkey. The total drug cost of SGK was around 40-50% of the whole SGK expenditures in 2009 (19).

When share of pharmaceutical expenditures in total healthcare expenditure is compared with that of OECD countries, the share in Turkey is above the average of OECD countries. This rate was approximately 25,9% according to year 2013 data. Corresponding rates were 12,6% for the USA, 15,8% for the United Kingdom and 14,8% for Germany (18).

According to data from Pharmaceutical Manufacturers Association of Turkey (İEİS), the drug market reached 1,2 trillion USD and Turkey ranked 17th in this course. Comparing total drug markets of the countries are given below in Figure 7 (20).

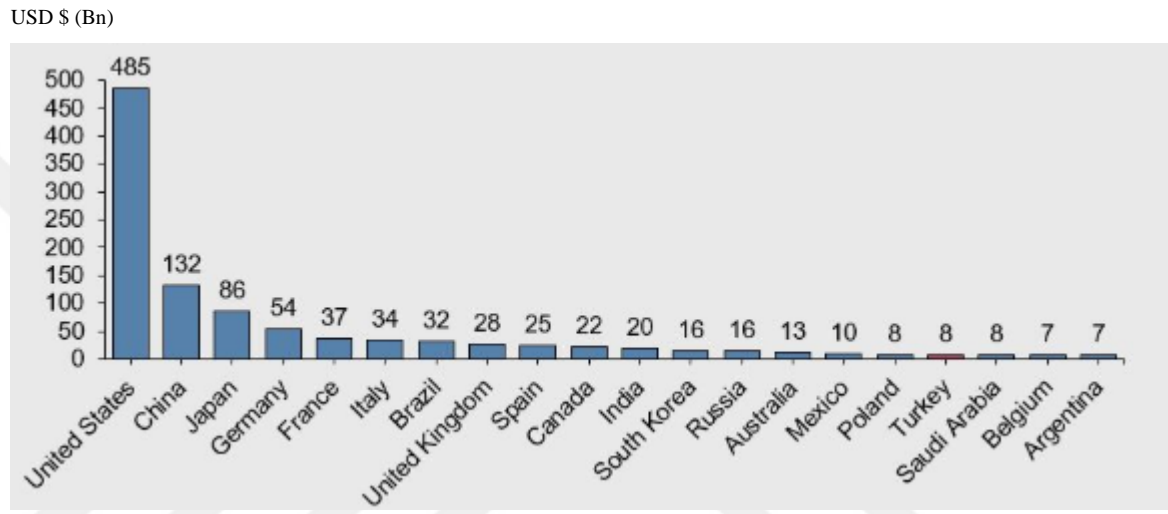


Figure 7: World Drug Market, 2018

In 2018, Turkish drug market calculated as 30,9 billion Turkish Liras (TL). In the same year, unit sales were found 2,3 billion units (20). From 2010 to 2018, market volume was increased approximately 130% in value and approximately 44% in unit. Incremental cost of drugs was also focused.

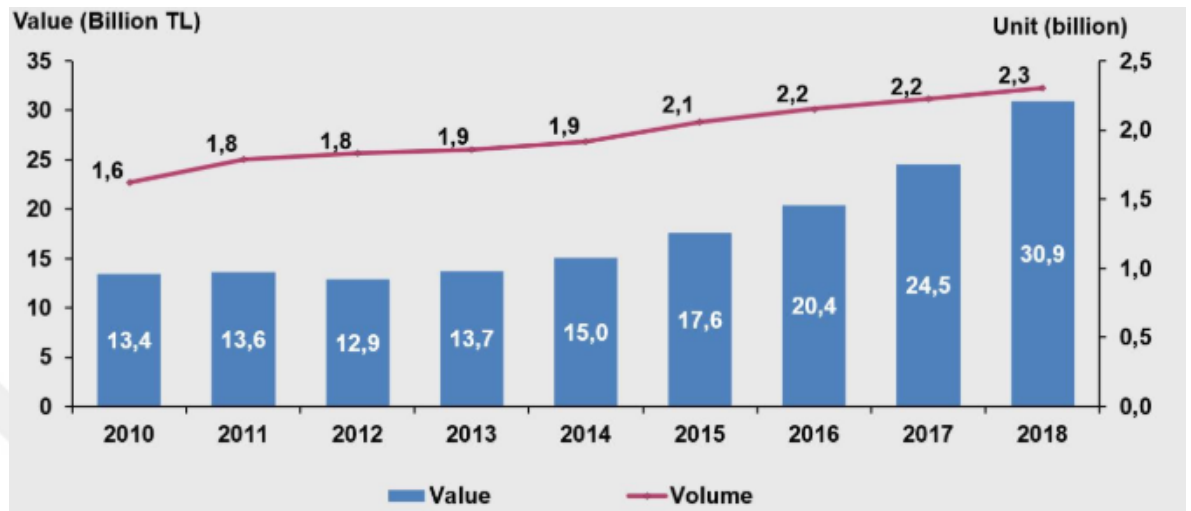


Figure 8: Turkish Drug Market, 2010-2018

In a report from IQVIA, therapeutic areas of medicine spending in selected developed and pharmerging markets. United States, France, Germany, Italy, Spain, United Kingdom, Japan and Canada were counted as developed countries whereas China, Brazil, Russia, India, Turkey and Mexico were counted pharmerging countries (12).

Table 4: Leading therapy areas spending and growth in selected developed and pharmerging markets

Therapy Areas	2018 Spending US \$	2014-2018 Compound Annual Growth Rate in US \$
Oncology	99,5	13,1%
Diabetes	78,7	15,2%
Respiratory	60,5	5,7%
Autoimmune	53,5	15,4%
Pain	39,7	0,9%
Antibiotics and Vaccines	40,6	2,3%
Mental Health	35,5	-2,6%
Blood Coagulation	39,8	13,1%
Hypertension	29,9	-3,6%
Immunology	34,2	11,7%
All others	392,7	4,8%

IEIS reports show also therapeutic classification of the drugs sold in Turkey drug market (19). As similar to selected market trends, oncology drugs have the highest proportion in the drug market in Turkey. Figure 9 shows details of therapeutic classes of Turkey markets (20).

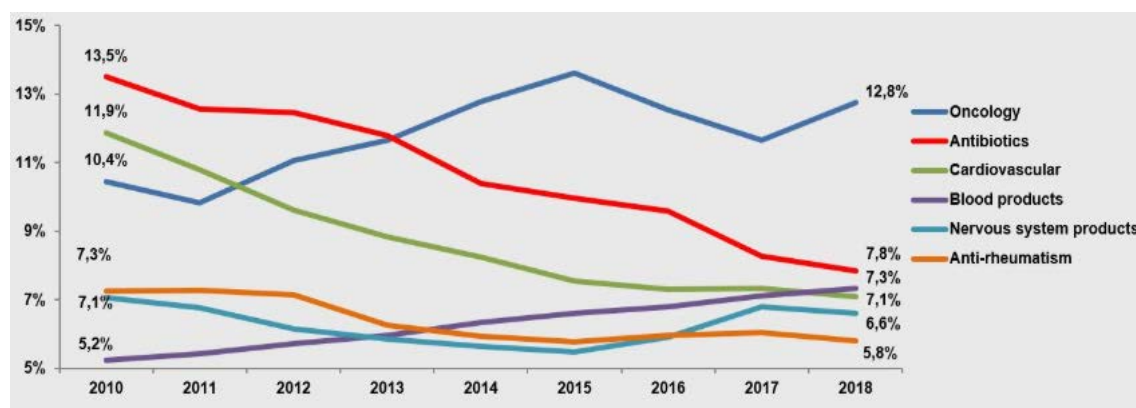


Figure 9: Therapeutic Classes in Turkey Market in TL, 2010-2018

In many developed countries, any medication except OTC products are not allowed bought without a prescription from a community pharmacy. This rule is theoretically available but not in practice in many of the countries like in Turkey. It varies between with the regions but approximately 70% of the medicines in Turkey can be purchased with a prescription in order to get benefit from paybacks (of reimbursed drugs) of the health insurances (21) except special diagnosis and conditions. OTC drugs and supplements are not covered by health insurance in Turkey. There is limited number of OTC drugs and supplements (like pastils, vitamins, etc.) covered by private insurance.

Briefly, Turkey has a good potential in global drug market with its increasing value. Cost of drugs has increased like expenses of unused/wasted medicines globally, also in Turkey.

2.2. Economical Burden of Unused/Wasted Drugs

2.2.1. Unused/Wasted Drugs

As seen above, the drug consumption is widespread globally to cure, to prevent or to relieve the diseases. As a part of the global problem of irrational drug use, unused drugs and medicine wastage have vital importance to concern. Handling of this problem is getting harder day by day.

Unused drug was defined as a drug which is purchased, whether according to a prescription or not, but which is not administrated (22). Definition of hoarding is in cases where multiple drugs were retained in the home, particularly when drugs were no longer needed or had expired. Hoarding habit induce unused drugs to build up in the home (23). Hoarding and the presence of the unused drugs at home finally leads to wastage of the medication. In all-round definition of medicine waste, "Medication wastage refers to any medication which expires or remains unused throughout the

whole medicines supply chain. Also refers to the unnecessary or inappropriate consumption of medications by patients, or the unjustified non-adherence to treatment guidelines by healthcare professionals. Medication wastage poses a financial burden on patients themselves and the state's economy and requires adequate education of all people concerned” is stated (24). Drug waste may be due to poor compliance to therapy, excessive and irrational prescribing, death of the patient, the lack of control of the sales of prescription medications in the pharmacy or etc (25-27).

2.2.2. Unused/Wasted Drug Costs

Obviously, medication wastage and unused drugs are economical losses for the health financing. There are a lot of studies to evaluate the burden of unused/wasted drugs but the results can be only estimations because of the limitation about the topic (such as not being able to reflect all public or region, limited access, not willing to share information or drugs, etc). Although the real cost cannot be measured, the studies show wasted or remained quite high value.

Irrational drug use habits and non-compliance are counted as main causes of unused drugs and medication wastage. Many studies suggest that about 50% of the patients do not comply with the prescribed medication. Hospital costs due to patients' noncompliance are estimated at \$ 8,5 billion each year (21).

The economic burden of unused drugs and medicine wastage according to researches can be summarized in searches below:

In data from a study Great Britain in 2007, the medicines returned to pharmacies each year for disposal is around £230 million worth and it is estimated

(28). According to another report in England, the value of unused medicines returned was £100 million annually in 2007 (29).

A research from Saudi Arabia and Gulf countries in 2003 showed that families in Saudi Arabia and other Gulf countries spent totally \$150 million on medications that were not consumed. In Oklahoma, it is estimated that between \$2,3 to \$7 million worth of unused prescription drugs are destroyed in nursing homes annually (30). As much as \$1 million worth of prescription drugs are wasted each year in San Mateo County (a county in California, USA) and had a population of 718,451 – because of patients die or their medications are changed by health care professionals (31).

A study conducted in Alberta in 1996, Canada counted in drug returns over a two-month period and stated that people making returns brought back an average of 60% of the drugs from the original prescription drugs. The dollar value of these medicines was more than \$700.000 over two months period, when it is extrapolated to include the whole province (32). According to a similar study from Houston in 2002, over a six-month period for oral pills alone wastage for the state was estimated \$53 million (33). Medication waste was estimated at between £30 and £90 million per annum in 2004 based on the research conducted in the United Kingdom (28). In 2005, New Zealand Pharmaceutical Management Agency assumed an expenditure of \$565 million for medications. Potentially, this value 6% equates to \$34 million dollars wasted in New Zealand in the same year (21). In a survey carried out in England and Wales in 1978, an estimate suggests that roughly £23 million of prescription medication (%5-6 of the total) is wasted yearly (34).

In 2001, a cross-sectional study with elderly people estimated that 2,3% of all drug costs is from drug waste. This would represent over \$1 billion in medicine waste in the elderly population in the United States (35).

In a study held in different areas in the north of Jordan in 2007, 2835 medication items found in the 435 selected houses as unused worth 9.593 JD (1 JD = US\$ 0,71) with an average cost of 22,1 JD per family. The total cost of unused medicines in Jordan was estimated at 6.326.000 JD and the total cost of expired drugs in Jordan was estimated at 1.267.000 JD in 2007 (36). Another study from Saudi Arabia in 2003 estimates 10 million USD valued medicine were wasted annually (30).

The studies mentioned above are before 2010. In last decade, studies related unused/wasted drugs was increased than before. New researches make clearer the extend of the problem. New searches related burden of the unused and wasted medicines summarized below:

In primary care, it has been estimated that prescription items worth approximately £300 million are wasted each year (37). A study from Adana (in Turkey) in 2013 showed that 222 box unused drugs with total 4.666 TL were collected from 52 voluntary families (38).

Bach et al (39) conducted a research in the United States in 2016 related cancer drugs discarded as unused due to inappropriate dose size (dosed by body size and were packaged in single-dose vials). The cost of wasted cancer drugs is estimated around 1,8 billion USD approximately 10% of the total cancer drugs revenue (39). Similarly, a study from Turkey pointed that unused drugs calculated near 6.500 USD for 117 cancer patients with different therapies in 2 months (40). Based on the results of a study in Japan, the estimated annual waste cost of unused medicine for Japanese patients with cancer who died was around USD 110 million in 2018 (41).

A cross-sectional, observational two-phased study was conducted using in Southern California in 2014. The results show that two out of three dispensed

medications were remain unused, with national projected costs ranging from USD 2,4 billion to USD 5,4 billion (42).

In a thesis from Slovenia in 2012, the value of returned medicines in community pharmacies in was estimated to amount to €3,77 million (43). A study from Vienna, Austria in 2018 collected 1.089 items by the Vienna Municipal Waste Department. The total cost of wasted medicines calculated as €1.965 at ex-factory price, of €2.987 at reimbursement price and of €4.207 at pharmacy retail price gross levels (44). As another example, National Prescription Drug Take-Back Day coordinated a several times each year by the United States Drug Enforcement Administration. An event in October 2017 utilized over 5.000 community collection sites across the United States. A total of 912.305 pounds of unused medicines were collected with unknown cost (45). In a take back event of Findlay University (in USA) of Pharmacy in 2013, total of 786.882 dosing units estimated to be worth approximately USD 1.118.020 were collected (46). Australia also holds medicine returning programs. An audit of these programs in 2015 showed that over 600 tonnes of medicines with the value of more than USD 2 million are returned through the program (47).

In a study to determine economic value of unused oral anti-cancer and biological disease-modifying anti-rheumatic drugs as expensive therapy in The Netherlands in 2018, 1173 patients were included and unused drugs found 59 packages with a total value of €60.341 (48). As mentioned in a study in Taiwan, the cost of unused medications is around USD 1 billion in 2013 (49).

A study from the United Kingdom in 2012, medication waste because of switching between regimens in HIV clinic happens occasionally. The total value of wasted drugs in 97 patients was £ 16.074 in 25 days (50). In another study in the United Kingdom in 2013, the cost of unused expensive anti-TNF therapy was found

£35.500 (representing 1,4% of £2,5 million annual biologics spend in the United Kingdom) (51).

Speer et al, conducted a research on hospice patients in 2013. According to the results, the total estimated cost for all medications discarded due to the death of the patients for the study period amounted to \$14.980 (52).

In a review about medicine waste in 2015, it was stated that cost of medication wastage was estimated as ranging from around 66 Euro to over 770.000 Euro differing from region to region (53). Additively, there is a burden for the safe disposal of unused/wasted drugs which is not cheap (21). It is paid insufficient attention to the cost of the disposal option generally. When considering the real burden of medication wastage and unused medicines, the cost of safe disposal options should be added to cost of unused/wasted drugs as an environmental responsibility.

2.3 Occurrence of Unused/Wasted Drugs

Unfortunately, increase in drug consumption induces unused drugs and medicine wastage, globally. There are several factors influencing the occurrence of medication waste and unused drugs.

2.3.1. Rational Drug Use

One of the main reasons of the occurrence of unused medicines is irrational use of drugs. Rational drug use is defined as “where patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time, and at the lowest cost to them and their community” at the Nairobi Conference by WHO in 1985. (19,54).

The factors affecting rational drug use is a broad topic to investigate. There are many searches about it recently. To summarize it, a diagram (Esra's modelling on Factors Effecting Rational Drug Use) was used at Figure 10 below (22, 29, 55-68). In this diagram, "+" represents inducing compliance and "-" represent negative effect on adherence to the therapy. If there are both of "+" and "-" symbols, this represents situational changes can occur negative to positive or vice versa.

As an important issue, universalizing rational drug use can decrease unused/wasted drugs and their burden at quite high rate. To increase rational drug use, education about therapies and drug usage, harmful effects of unused/wasted medicines should be given globally.

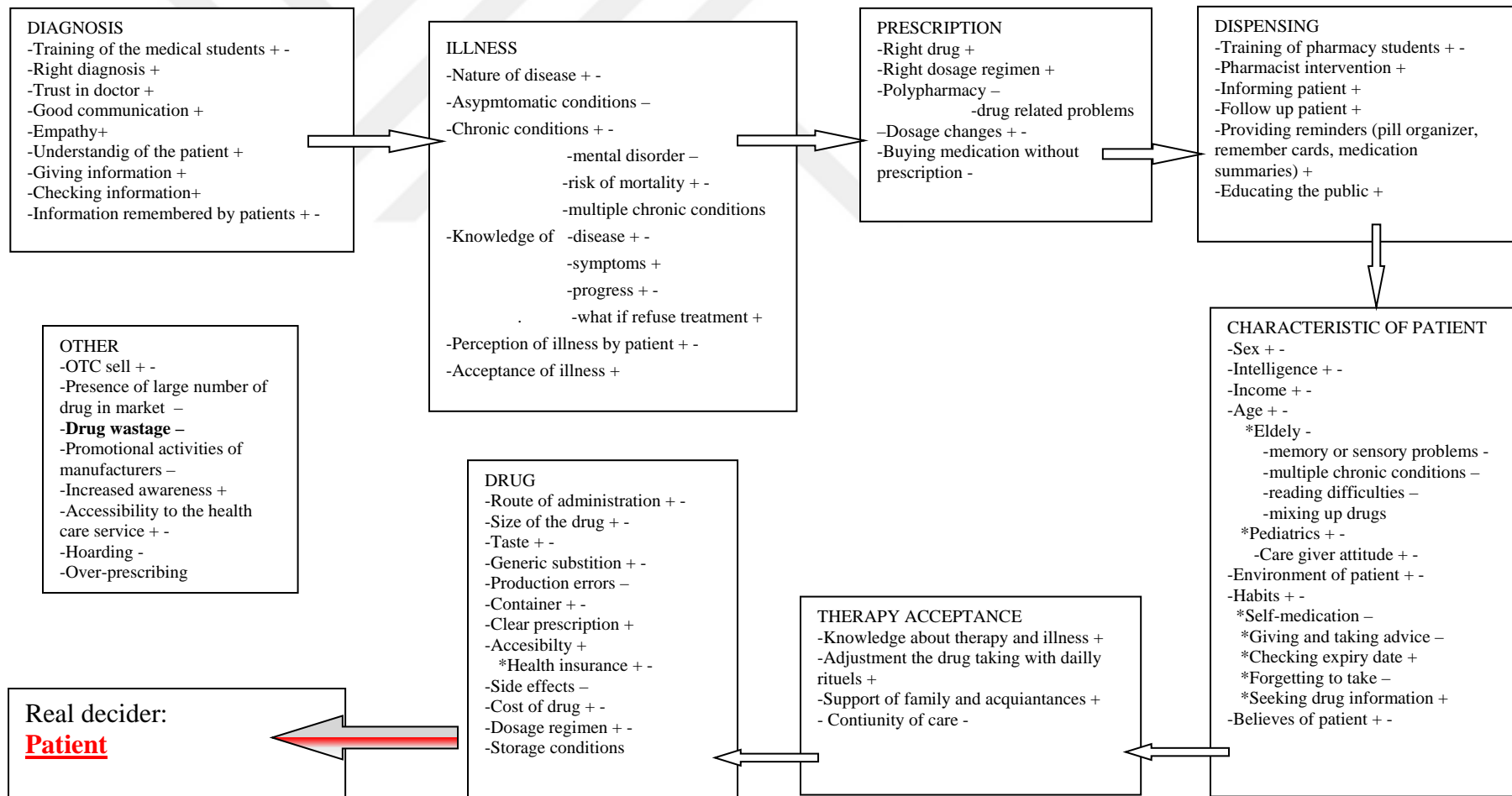


Figure 10: Diagram of Esra's Modelling on Factors Effecting Rational Drug Use

2.3.2. Other Factors

There are many reasons apart from irrational drug use for occurrence of unused/wasted drugs. These reasons may be changing by the time and by regional differences on health care application.

In the beginning, aging of the world population increases chronic diseases and so increase in drug consumption and waste (69). There have been many new illnesses result from genetic and environmental reasons, animal originated conditions, migratory people and unknown reasons. To cure these, new and costly medicine like therapy options were needed (17). Recently, pharmaceutical and biotech industries launched many new treatments. These new therapies have come with a financial cost (70). Thus, waste and unused part of these medicines increase the burden.

In addition to these, in the hospital application, medicines dispensed during inpatient stay, which are not required on discharge, not transferring of medicines from the point of admission to the ward or between wards and clinical areas with the patient, subsequent change in patient's treatment plan, patients own drugs not returned to the patient on discharge like conditions induce the occurrence of drug wastage and unused medicines (71) . For cancer patients, intravenous drugs administered through body-surface area or weight-based dosing can be result of medicine wastage due to large and/or limited fixed vial sizes, and vial sharing restrictions (39, 72). This is also a reason for medicines with similar route of administration remain unused or wasted.

Death of the patient/a family member, change in prescription, too large pack sizes, repeat filling of prescriptions without assessing the amount at hand, leftovers of small quantities in topical dosage forms, perceptions about the need for the medicines and unwanted effects, expiration of medicine, environmental reasons and

improvement of the patient like factors can be counted as reasons for occurrence of unused medicine and medication wastage (44, 47, 73, 74).

These reasons are picked up from related studies. However, the reasons are not limited with these reputed factors. Different factors may occur situationally or over the time.

2.4. Environmental Effect of Unused/Wasted Medicine

Unused drugs remained at home have imposed significant cost on health systems in many countries globally. The phenomenon of remained unused/wasted medicines can have several consequences, including wasting nation's resources, incomplete treatment courses, medication side-effects left unregistered, intentional or accidental drug poisoning by households and pets, self-medication, increase medication resistance (e.g. antibiotics), possible genetic effects in humans, abusive use and environmental pollution (42, 75, 76).

Pharmacopollution is defined as “a public health and environmental outcome of some active pharmaceutical ingredients and endocrine-disrupting compounds dispersed through water and/or soil” (76). Medicines should be managed in an environmentally responsible manner like plastics, paper and glass. The recycling of drugs is generally illegal, because the drugs no longer have the assurance or guarantee of strength, quality, purity or storage condition after dispensed (77).

Disposal of unwanted medications (unused/wasted drugs especially expired) via environmentally-unfavorable routes such as the sink, toilet or household garbage are important factors contributing to water and ground contamination and the overall environmental occurrence and accumulation of pharmaceutically active compounds (49, 78). The studies about pharmacopollution risks to environment, life, and water resources became more prominent in recent years (76, 79).

Active pharmaceutical ingredient (API) potential ecotoxicity and environmental impact compile the toxicity of main human medicine groups to aquatic organisms:

- Extremely toxic ($EC_{50} < 0,1 \text{ mg l}^{-1}$): antibiotic (for microorganisms);
- Very toxic compounds ($EC_{50} 0,1-1 \text{ mg l}^{-1}$): antibiotic (algae), antidepressant (crustaceans), cardiovascular drugs (crustaceans), and cytostatic (microorganisms);
- Toxic compounds ($EC_{50} 1-10 \text{ mg l}^{-1}$): analgesic (crustaceans) and antiepileptic (cnidarian);
- Harmful compounds ($EC_{50} 10-100 \text{ mg l}^{-1}$): analgesic and cytostatic (crustaceans and fish);
- Non-toxic compounds ($EC_{50} > 100 \text{ mg l}^{-1}$): antiepileptic (crustaceans and fish) and X-ray contrast (microorganisms, algae, cnidarian, crustaceans, and fish).

In the United States, 81% of 47 groundwater samples from 18 states had organic effluent contaminants (80). The maximum concentrations of API detected in USA samples are (80):

- a) Antianginal: dehydronifedipine ($0,022 \mu\text{g/l}$);
- b) Human and animal antibiotics: lincomycin ($0,32 \mu\text{g/l}$), sulfamethazine ($0,36 \mu\text{g/l}$), and sulfamethoxazole ($1,11 \mu\text{g/l}$);
- c) Antidepressant: fluoxetine ($0,056 \mu\text{g/l}$);
- d) Antihypertensive: diltiazem ($0,028 \mu\text{g/l}$);
- e) Anti-inflammatory: ibuprofen ($3,11 \mu\text{g/l}$);
- f) Antipyretic and analgesic: acetaminophen ($0,38 \mu\text{g/l}$);
- g) Stimulant: caffeine ($0,13 \mu\text{g/l}$); and
- h) Caffeine metabolite: 1,7-dimethylxanthine ($0,057 \mu\text{g/l}$).

Several mood stabilizers, analgesic, antibiotic, anticonvulsant, anti-inflammatory, antimicrobial, analgesic, and other API are detected in water from USA, Spain, and Germany (76, 80).

API is present in sewage treatment plants (STP), soil, and even in tap water (76, 81). Water and STP are not specifically designed to eliminate micropollutants, therefore API can remain in tap water (82).

Environmental effects of API in nature can be summarized as below:

Zenker et al. reviewed the highest bioconcentration factors for fish which are diclofenac (liver: 12–2732), fluoxetine (185–900), gemfibrozil (113), and norfluoxetine (body: 80–650). Other animals are also affected by pharmacopollution, (76, 83). The white-rumped vulture (*Gyps bengalensis*) was the most common raptor bird in India until the 1990s, when its population decreased 95% due to visceral gout and renal failure related to diclofenac as the cause of death (76). Fluoxetine decreases goldfish (*Carassius auratus*) feed intake and weight gain and inhibits ova production of zebrafish (*Danio rerio*) (84). Fathead minnow (*Pimephales promelas*) exposed to household effluents in Boulder (Colorado) (Estrogen 17 β -estradiol, estrone, estriol, 17 α -ethinyl estradiol, estrogenic alkylphenols, and bisphenol A were detected in Boulder effluent) showed a demasculinization process. Fish's sperm abundance changed, as well as its nuptial tubercles and dorsal fat pads after 14 days of exposure.

Fathead minnows (*Pimephales promelas*) exposed during 21 days to 305 and 1.104 $\mu\text{g/l}$ of venlafaxine and 0,0052 $\mu\text{g/l}$ of sertraline presented mortality and anatomical modification in their testicles. Ciprofloxacin, enoxacin, and sulfamethoxazole in Laizhou Bay and salt water (China) aquatic environments raised potential ecological damages to bacteria *Vibrio fischeri*. Psychoactive drugs cause acute and chronic toxicity to invertebrates, algae, fish, and crustaceans. Tap water analysis in Guangzhou (77,5% samples) and Macao (100% samples) detected norfloxacin, ciprofloxacin, lomefloxacin, and enrofloxacin (76).

The major concerns have been increased bacterial resistance to antibiotics and interference with growth and reproduction not only in human but inside aquatic

organisms such as fish and frogs, too. It has been shown that impaired sexual development and increased feminisation of fish have occurred due to the presence of trace amount of ethinyl oestradiol in rivers (74).

Targeted ecotoxicological studies are lacking almost entirely even in developed countries (74). Besides, any formalized protocols for the disposal of unused medications do not exist in many countries (85) also in Turkey.

It was concluded that the best destination for unused/wasted medicines is the littering (mixing waste with an unpalatable substance, such as kitty litter or used coffee grounds, placing the mixture in a sealed plastic container, and putting that sealed container into the household trash receptacle), followed by landfill or incineration disposal (76). Although the opposite opinions exist (86), incineration is most used method to destroy unwanted medication as an accepted environmentally safe way.

Unwanted/unused/wasted medicine collection campaign or collection boxes like organizations can be useful to reduce environmental effects of API. In addition to these, policy makers have to generate guidelines about the subject all over the world.

3. MATERIAL AND METHODS

3.1. Aim of Study and Hypothesis

The main aim of the study is to analyze economic burden of unused and wasted medicine from the point of view of drug use habits. The hypotheses are listed below:

- Central nervous system drugs are mostly wasted.
- Expired drugs are kept home at least 6 months after expiration date.
- People tend to waste generic drugs more than originals.
- Economical burden of unused and wasted medicine is huge.
- Parenteral dosage forms are most likely to be unused.
- Prescription drugs more likely wasted than OTC and supplements.
- People keep reimbursed drugs at home for future use.
- Cost of drugs and their burden in SGK system have increased over 9 years.
- Wasted drugs do not include unopened packs.

3.2. Population and data set

The population studied was the people who participated in voluntarily the campaign in Yeditepe University. There were around 18.000 students and 2.000 staff in the Yeditepe University 26 August Campus in 2010. According to recent data, 21.640 students and around 2.100 staff are present in the campus.

3.3. Place of Study

The study was conducted in Yeditepe University 26 August Campus located in Kayisdagi-Atasehir in Istanbul. There are thirteen faculties, five institute, one foreign language academy, one vocational academy, two foreign language

preparatory schools five dormitories and one guesthouse in the campus now. Participation of all students, teaching and research staff and the other personnel was requested voluntarily for The Unused Drug Collection Campaign.

3.3.1. Campaign Publicity

The campaign was publicised in four different ways. Firstly, weekly e-mails were sent to university mail of all students and staff. Posters about the campaign were distributed to the panelboards in all buildings of the campus. T-shirts that carried the advertisements of the campaign were worn and vocal announcements were made especially at the time of Yeditepe University May Fest 2010 for 4 months.

3.4. Type of Study

An unused medicine collection campaign was conducted in Yeditepe University 26 August Campus between 26 April - 6 August 2010 by Yeditepe University Drug and Poison Consultancy Unit (YUDIC). Data from recorded pharmaceuticals were tabled. The study is an observational and descriptive study and data analysis method was used for data collected in campaign. The collected items were destroyed via environmentally safe way (incineration). The external packages of collected drugs with container were recycled with help of Ataşehir Municipality.

3.5. Data Set

One hundred and seven persons got involved in the campaign and brought unused medicines. 1230 box item was collected (brought cosmetics, veterinary medicine, repellents, unclassified items saved also). Collected medicines are noted a Microsoft Office Excel Sheet with their brand name, active ingredient, collection

date, number of the participant, dosage form, strength, number of boxes, condition of container, condition of price clipping, condition of being drug sample and foreign drug, original/generic status, prescription status, The Anatomical Therapeutic Chemical (ATC) group, therapeutic group and sub group, expiration date, expiration status, original content of box, remained content, usage status. Pharmacy price and price of SGK was added for both years of 2010 and 2019. Also, people who participated in the campaign were asked to complete the questionnaire. The questionnaire was conducted among whoever consented to answer and brought unused drugs for the campaign. and 65 of them agreed to answer the questionnaire. The analysis of results in the questionnaire was evaluated in a different thesis.

3.6. Data Analysis Technique

Recorded information of drugs in Microsoft Office Excel Sheets was analyzed with formulations in excel. Pivot tables are used mainly to calculate frequencies and percentages. To create chart and graphic in analysis, Microsoft Office Excel instruments are used again. Pricing data, drug feature (content, reimbursement status, generic/original status and etc.) and past data needed for analysis was provided from Rx Media Pharma Database. The assumption was made that all the drugs were dispensed with retail price or reimbursed price to SGK for the calculation. Also, when drugs expenses were calculating, the amount of drugs inside packs were taken into consideration. As a monopoly, the biggest buyer in drug market is SGK in Turkey and many drugs covered by SGK have discount with the fluctating rate of 10%-20%.

3.7. Ethical Approval

There was no obligation for ethical approval at the time of unused medicine collection campaign held (in 2010). Therefore, no ethical approval is needed to conduct the project. Official approval was obtained from the rectorship of university

and payments related inciration of collected products were afforded by university as a social responsibility project.



4. RESULTS AND DISCUSSION

In this chapter the results of frequency were tabulated and summarized. The frequency distribution of variables (demographics, unused drug related data like expiration date, dosage forms and etc.) used in the study and the comparison of different variable frequencies and pricing were given in the same headings. Crossing of variables are given in related section.

The aim of the study is to analyze economic evaluation of collected unused/wasted medicine from perspective of drug use habits. Due to the participants sample being made up from volunteer people and relatively low participation rate to questionnaire, the results were affected. Discussion related correlation or difference to past literature was given in the headings, too.

4.1. Frequencies

4.1.1. Demographics

Due to only 65 people in 107 answered the questionnaire, demographic data is lacking to show all participants except gender. The results of demographics cannot represent the general public, regarding volunteer basis of the campaign.

4.1.1.1. Gender

Table 5: Gender distribution

Gender	Frequency (n)	Percent (%)
Female	59	55,1
Male	48	44,8
Total	107	100,0

59 female and 48 male bring unused pharmaceutical items with total of 107 persons to the campaign.

4.1.1.2. Age

Table 6: Age group distribution

Age groups	Frequency (n)	Percent (%)
18-24	29	44,6
25-29	9	13,8
30-39	8	12,3
40-49	9	13,8
50 and older	5	7,7
Unanswered	5	7,7
Total of answered	60	92,3
Total	65	100,0

According to results of 65 people who answered questionnaire, The most frequently represented (44,6%) participants belonged to the 18-24 age group. The 25-29 and 40-49 groups were at 13,8% percentage, and secondary and tertiary sequence respectively. High rate in 18-24 age group was a result of holding in an university as expected.

4.1.1.3. Education

Table 7: Age group distribution

Education level	Frequency (n)	Percent (%)
Primary school	2	3,1
High school	3	4,6
College	7	10,8
University	36	55,4
Master	5	7,7
Doctorate	12	18,5
Total	65	100,0

Results of questionnaire shows that most of the respondents (n=36) had university education with the rate of 55,4%. In addition, 18,5% of the respondents had a doctorate degree, 10,8% of them graduated from college, 3 people from high school and 2 people from primary school who were thought to be staff. 7,7% of the respondents had a master degree, also. University educating people were predominated due to holding in a university expectedly. In addition, master and doctorate educating people can be academic staff and teachers working in the university.

4.1.1.4. Occupation

According to the distribution of the respondents to the survey, most of the respondents (43,1%) were pharmacy students. 41,5% of them was university personnels and students. 10 respondents were from the pharmacy teaching staff. As a project holding in faculty of pharmacy, higher rate of participation from the faculty was seen in accordance with expectations.

Table 8: Occupation distribution

Occupation	Frequency (n)	Percent (%)
Pharmacy teaching staff	10	15,4
Pharmacy student	28	43,1
University personnel and student	27	41,5
Total	65	100,0

4.2. Frequency and Cost of Variables

A total of 1230 pharmaceutical item were collected from 107 persons. Also, cosmetics such as baby powder, creams, hair dye and repellents were brought suprisingly. As mean, 11,5 items were brought per person with the standard deviation of 13,5. In general view, two calculation was used. Retail price was calculated to show total burden to public and SGK price was calculated to see wasted resources of

health insurance system in Turkey. As expected hypothesis, cost of drugs and their burden in SGK system have increased over 9 years.

Table 9: Value of collected drugs due to years 2010 and 2019

Values	Total TL	Total USD	Mean TL/per drug
2010 retail price	8.086	5.389*	7,21
2010 SGK price	6.114	4.075*	6,21
2019 retail price	13.526	2.293**	12,81
2019 SGK price	8.721	1.478**	10,00

*Calculated with 2010 exchange rate (1,5003 TL)

** Calculated with April 2019 rate (5,9 TL)

Retail prices were 8.086 TL and 13.526 TL in 2010 and 2019, respectively. SGK prices are found as 6.114 TL and 8.721 TL in the same years. As seen on the Table 9, although total expenditure increased in both pharmacy price and SGK price in TL, a decrease in USD expenditure appeared in 2019 due to change in exchange rate of USD.

According to data on Turkish Statistical Institute, population of Turkey was found 73.722.988 in 2010 and 82.003.882 in 2018 (16). In spite of not representing the public, if an extrapolation was made to estimate total burden, it was found that SGK cost would be 18.986.619,57 TL in 2010 and 30.124.509,47 TL in 2019 and total cost wasted would be 25.110.534,16 TL in 2010 and 46.722.178,09 TL in 2019. Although, low participation was provided to our campaign (participation rate %0,0045), these extrapolation would represent approximately 0,004% of total health expenditure of Turkey and 0,021% of the total drug market in Turkey. As expected in hypothesis, a huge wastage of unused drugs exist in Turkey like all over the World.

4.2.1. Active Ingredient

340 different active ingredient (with combinations) containing product was collected in the campaign. The most gathered API was paracetamol (n=59). Surprisingly, ipratropium bromide was gathered with the rate of 3,5% which is more than expected. Like ipratropium bromide, vitamin combination with 1,95 rate was collected and remained unused in home as surprisingly.

Table 10: Distribution of active ingredient

Active Ingredient	Frequency (n) (box)	Percent (%)
Paracetamol	59	4,80%
Ipratropium bromide	43	3,50%
Vitamin combination	24	1,95%
Acetylsalicylic acid	22	1,79%
Calcium carbonate	22	1,79%
Ibuprofen	21	1,71%
Pantoprazol	20	1,63%
Diclofenac potassium	19	1,54%
Acetylcysteine	17	1,38%
Amoxicillin	16	1,30%
Thiocolchicoside	16	1,30%
Other	951	77,32%
Total	1230	100%

Results show that ipratropium bromide had the biggest percentage (11,26% and 11,47%) in both total expenditures and SGK expenditures. Memantin with 412,48 TL value and sevelamer with 388,77 TL value were second and third in line. Difference existing in vitamin combination resulted from appearance of few reimbursed product in SGK system. Vitamin combinations can be bought without prescription so the results are represent retail for these kinds of products.

Table 11: Value of Active Ingredient in TL, 2010

Active Ingredient	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Ipratropium bromide	910,38	11,26%	700,97	11,47%
Memantin	412,48	5,10%	367,10	6,00%
Sevelamer	386,77	4,78%	297,81	4,87%
Vitamin combination	232,62	2,88%	8,51	0,14%
Escitalopram	226,34	2,80%	201,44	3,29%
Sultamicillin	182,54	2,26%	159,02	2,60%
Pantoprazol	180,81	2,24%	117,83	1,93%
Acetylcysteine	133,43	1,65%	118,87	1,94%
Lansoprazol	128,84	1,59%	113,79	1,86%
Amoxicillin	118,75	1,47%	106,05	1,73%
Moxifloxacin	115,05	1,42%	68,89	1,13%
Others	5.057,53	62,55%	3.853,68	63,03%
Total	8.085,54	100,00%	6.113,95	100,00%

In values of 2019, ipratropium bromide stayed on top of expenditure list. Some drugs like memantin containing has lower price in 2019 due to change in pricing application in the period. In addition, some drugs like sevelamer are not reimbursed any more.

Table 12: Value of Active Ingredient in TL, 2019

Active Ingredient	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Ipratropium bromide	1.809,83	13,38%	1.303,13	14,94%
Sevelamer	364,56	2,70%	0,00	0,00%
Vitamin combination	333,44	2,47%	18,74	0,21%
Memantin	317,75	2,35%	228,78	2,62%
Azelaic acid	281,71	2,08%	0,00	0,00%
Paracetamol	251,93	1,86%	165,16	1,89%
Sultamicillin	202,18	1,49%	148,93	1,71%
Tolterodin	184,42	1,36%	108,81	1,25%
Escitalopram	183,38	1,36%	137,95	1,58%
Amoxicillin	180,63	1,34%	169,53	1,94%
Lansoprazol	178,50	1,32%	136,17	1,56%
Others	8.953,19	66,19%	6.303,93	72,28
Total	13.525,89	100,00%	8.721,13	100,00%

Difference in frequencies and pricing were exist for API but ten ten drugs remained unused did not show a big chance. Paracetamol, ipratropium bromide vitamin combination, pantoprazol, acetylcysteine and amoxicillin were at the top of the list of frequency and pricing both 2010 and 2019. High waste rate of vitamin combinations may be result of unnecessarily dispensing of vitamins as irrationally and not being used. Expected high income level of university and broader coverage of private health insurance may also be reasons.

In a study in Mexico in 2014, paracetamol (28%) and aspirin (10%) were the most collected drug in unused drug collection campaign (27). In another study in Jordan in 2012, amoxicillin, paracetamol, metronidazole, antihistamines, hypoglycemic medications, and adult cold medications were mostly found as unused in household (36). Paracetamol (202, 8.4%), diclofenac (98, 4.1%) and amoxicillin (79, 3.3%) were the most commonly reportedly stored in household and remain unused in another study from Jordan in 2013 (87). Among drugs stored in home, diclofenac (10.7%), paracetamol (9.9%) and amoxicillin (8.0%) were on top in a study in Ethiopia in 2017 (88). The results in these studies and results of this thesis run parallel generally to each other despite being different region and timeline.

4.2.2. Dosage Forms

30 different dosage form gathered from the campaign. Also, unknown and unclassified (others) items were recorded. 549 box tablets (44,63%) and 109 box (8,86%) capsules were found which forms more than 50% of total collected products. Among the dosage forms, there was a flu vaccine, interestingly.

Table 13: Distribution of Dosage Forms

Dosage Forms	Frequency (n) (box)	Percent (%)
Tablet	549	44,63%
Capsule	109	8,86%
Injectable	77	6,26%
Cream	68	5,53%
Syrup	54	4,39%
Inhaler	46	3,74%
Dragee	43	3,50%
Pomade	42	3,41%
Spray	33	2,68%
Drop	28	2,28%
Gel	28	2,28%
Solution	24	1,95%
Ointment	23	1,87%
Suspension	20	1,63%
Pastil	20	1,63%
Sachet	18	1,46%
Lotion	10	0,81%
Suppository	8	0,65%
Gargle	6	0,49%
Emulsion	5	0,41%
Granules	4	0,33%
Other	2	0,16%
Tincture	2	0,16%
Poudre	2	0,16%
Enama	1	0,08%
Oral Solution	1	0,08%
Tonic	1	0,08%
Vaginal Tablet	1	0,08%
Unknown	1	0,08%
Vaccine	1	0,08%
Dye	1	0,08%
Nasal Spray	1	0,08%
Lacquer	1	0,08%
TOTAL	1230	100,00%

66,42% of collected pharmaceuticals were in oral dosage forms. Topical, injectable and inhaler forms were in line with the rate of 21,87%, 6,34% and 3,74% respectively. This may be result from preferring mostly oral dosage form keeping home for future use due to simple usage.

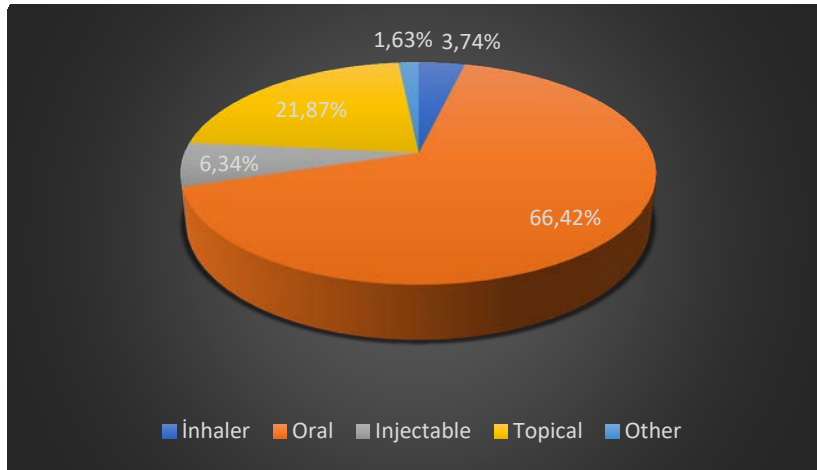


Figure 11: Distribution of dosage forms in general

Table 14: Value of Dosage Forms in TL, 2010

Dosage Forms	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Tablet	4.158,82	51,44%	3.337,26	54,58%
Inhaler	990,97	12,26%	763,43	12,49%
Capsule	758,92	9,39%	492,13	8,05%
Cream	327,52	4,05%	246,96	4,04%
Syrup	266,15	3,29%	146,03	2,39%
Injectable	217,30	2,69%	192,10	3,14%
Spray	174,69	2,16%	119,01	1,95%
Pomade	169,14	2,09%	132,30	2,16%
Gel	159,52	1,97%	96,25	1,57%
Dragee	129,07	1,60%	92,64	1,52%
Suspension	110,08	1,36%	96,71	1,58%
Drop	103,03	1,27%	86,17	1,41%
Sachet	93,39	1,16%	60,92	1,00%
Ointment	85,70	1,06%	62,48	1,02%
Solution	77,73	0,96%	34,92	0,57%
Pastil	70,38	0,87%	0,00	0,00%
Emulsion	37,10	0,46%	28,36	0,46%
Lotion	33,68	0,42%	27,85	0,46%
Gargle	32,07	0,40%	17,66	0,29%
Vaginal Tablet	23,69	0,29%	21,08	0,34%
Suppository	21,74	0,27%	20,17	0,33%
Nasal Spray	16,98	0,21%	15,11	0,25%
Vaccine	11,84	0,15%	10,54	0,17%
Granule	8,34	0,10%	8,01	0,13%
Oral Solution	4,42	0,05%	4,24	0,07%
Enama.	1,69	0,02%	1,62	0,03%
Tincture	1,56	0,02%	0,00	0,00%
TOTAL	8.085,54	100,00%	6.113,95	100,00%

According to prices in 2010, tablets were at the top of the list for both in retail expenditure and SGK expenditure. Rates of tablets in expenditure (51,44% and 54,58%) were higher than frequency rate (44,63%). Collected inhalers had relatively lower rate (3,74%) in frequency but had second line in total and SGK expenses with the rate of 12,26% and 12,49%. This may occur because of high prices of inhaler drugs.

Table 15: Value of Dosage Forms in TL, 2019

Dosage Forms	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Tablet	5.504,94	40,70%	3.679,65	42,19%
Inhaler	1.895,68	14,02%	1.372,70	15,74%
Capsule	1.283,27	9,49%	800,19	9,18%
Cream	886,55	6,55%	475,39	5,45%
Injectable	785,19	5,81%	444,41	5,10%
Syrup	359,45	2,66%	254,98	2,92%
Spray	303,65	2,24%	206,14	2,36%
Pomade	273,92	2,03%	210,76	2,42%
Ointment	264,15	1,95%	201,91	2,32%
Sachet	262,24	1,94%	47,93	0,55%
Suspension	244,56	1,81%	179,24	2,06%
Dragee	230,63	1,71%	222,63	2,55%
Pastil	177,65	1,31%	0,00	0,00%
Drop	176,87	1,31%	136,89	1,57%
Gel	174,80	1,29%	160,97	1,85%
Solution	142,37	1,05%	57,64	0,66%
Lotion	78,32	0,58%	35,92	0,41%
Lacquer	77,40	0,57%	0,00	0,00%
Gargle	66,71	0,49%	33,43	0,38%
Tonic	66,00	0,49%	0,00	0,00%
Emulsion	61,49	0,45%	55,33	0,63%
Suppository	50,90	0,38%	50,90	0,58%
Vaginal Tablet	39,90	0,29%	28,73	0,33%
Vaccine	27,90	0,21%	20,09	0,23%
Poudre	23,03	0,17%	0,00	0,00%
Nasal Spray	22,20	0,16%	18,20	0,21%
Others	19,00	0,14%	0,00	0,00%
Oral Solution	15,27	0,11%	15,27	0,18%
Granule	8,51	0,06%	8,51	0,10%
Enema	3,33	0,02%	3,33	0,04%
TOTAL	13.525,89	100,00%	8.721,13	100,00%

Striking decrease in expenditures of tablets for both retail and SGK with rate 40,7% and 42,19% in 2019 may be resulted from change in pricing. Price of injectable forms has risen with the rate of 5,81% and 5,1% in both expenses due to the same reason. Not being able to past price of poudre, tonic, lacquer like dosage forms made difference in 2019 expenditure data mainly. Appearance of these dosage forms not exist in 2010 value table was an important change.

Data from a report of a take back events in Vienna in 2014 shows that 87% of the total packs were oral dosage forms (73). In another study in the same place in 2018, it was found that medicines in oral form were by far the most common items, followed by items in dermal doses like result of this thesis (44). In a reseach held in the United States in 2013, 86.8% of total collected drugs in take back event were tablets, capsules, and liquid preparations (89). Nearly two-thirds of drugs found as unused were tablets, capsules, and liquid preparations in a study in the United States in 2014 (42). The results of literature and this thesis run nearly parallel with each other in general for unused /wasted dosage forms.

4.2.3. Original/Generic/OTC Types

On the contrary expectation hypothesis, more original pharmaceutical drugs were collected with the rate of 45,55% than generics. 25 packs cosmetics like not pointed items classified as others. Information about situation of 38 packs products could not be found so they were classified as unknown. According to results, there were 24 boxes veterinary medicines, suprisingly.

Table 16: Distribution of original/generic/OTC

Type	Frequency (n) (box)	Percent (%)
Original	547	45,55%
Generic	476	39,63%
OTC	91	7,58%
Unknown	38	3,16%
Others	25	2,08%
Veterinary	24	2,00%
TOTAL	1201	100,00%

The high percentage of original products can be a result of perception that original drugs are more effective than generic. As another reason, high income population was used in the campaign. As expectancy in hypothesis, prescription drugs more likely wasted than OTC and supplements.

Table 17: Value of Original/Generic/OTC in TL, 2010

Type	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Original	4.364,64	55,06%	3.503,51	58,57%
Generic	2.920,59	36,84%	2.477,23	41,41%
OTC	636,16	8,03%	0,00	0,00%
Unknown	4,09	0,05%	0,00	0,00%
Others	1,55	0,02%	1,49	0,02%
Veterinary	0,00	0,00%	0,00	0,00%
TOTAL	7.927,03	100,00%	5.982,23	100,00%

Percentage of original products (55,06% and 58,57%) in both total expenditures was more than collection frequency percentage of them (45,55%) in 2010. OTC products were not reimbursed. Veterinary drugs price could not be found in the databases so their price were not calculated.

Table 18: Value of Original/Generic/OTC in TL, 2019

Type	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Original	7.531,55	57,01%	5.044,91	59,26%
Generic	4.543,31	34,39%	3.463,69	40,69%
OTC	616,06	4,66%	0,00	0,00%
Others	521,01	3,94%	4,62	0,05%
Veterinary	0,00	0,00%	0,00	0,00%
Unknown	0,00	0,00%	0,00	0,00%
TOTAL	13.211,93	100,00%	8.513,22	100,00%

In 2019, increase in prices of drugs was seen generally. The percentages of original and generic drugs in total expenditure were not changed meaningfully. Past prices of others classes could not be found so their burden was appeared in 2019 value table.

Generally, range of original products in total expenditures was more than collection frequency percentage. This condition can emerged because of more expensive prices of original products than generics.

In the result of a take back event report held in the United States in 2015, 69.0% of all medications were generic products (90). In a study in the United States in 2014, approximately 60% generic drugs and around 40% were collected (42). The results of studies and the thesis do not run parallel in this topic may be due to regional differences existing in limited population.

4.2.4. Therapeutic Groups

Drugs from 52 different therapeutic groups were collected in the campaign. Therapeutic groups and subgroups are separated according to Rx Media Programme to unify them.

Table 19: Distribution of Therapeutic Groups

Therapeutic Groups	Frequency (n) (box)	Percent (%)
Gastrointestinal Drugs	150	12,49%
Dermatologics	128	10,66%
Antiinfectives	110	9,16%
Analgesics	100	8,33%
Vitamins and Minerals	87	7,24%
Cough and Cold Medicines	83	6,91%
Chronic Obstructive Pulmonary Disease Drugs	55	4,58%
Musculoskeletal System	52	4,33%
Nasal Drugs	42	3,50%
Oropharynx Drugs	40	3,33%
Antiinflammatory and Antirheumatic Drugs	40	3,33%
Antihistaminics	37	3,08%
Antihypertensives	28	2,33%
Other	249	20,73%
TOTAL	1201	100,00%

As not expected in hypothesis, gastrointestinal drugs (n=150) are the most common therapeutic group in gathered products. Dermatologicals and antiinfectives are on the second and third line with the range of 10,66% and 9,16% respectively. Analgesics, vitamins and minerals and cough and cold medicines groups are also top of the list.

If it is needed to go in details, 165 therapeutic sub groups were identified in analysis of collected drugs.

Table 20: Distribution of Therapeutic Subgroups

Therapeutic Subgroups	Frequency (n) (box)	Percent (%)
Non-Steroidal Anti-Inflammatory Drugs (NSAID)	130	10,82%
Adrenergic Inhalers	46	3,83%
Cold and Flu Combinations	43	3,58%
Antacids and Antiflatulans	43	3,58%
Topical Corticosteroids	31	2,58%
Proton Pump Inhibitors (PPI)	30	2,50%
Central Acting Muscle Relaxants	30	2,50%
Nonsedative H1 Receptor Antagonists	28	2,33%
Cephalosporins	25	2,08%
Antispasmodics and Other Drugs Altering Gut Motility	24	2,00%
Penicillin-Beta Lactamase Combinations	22	1,83%
Multivitamin and Mineral Combinations	21	1,75%
Others	728	60,62%
TOTAL	1201	100,00%

According to results, Non-Steroidal Anti Inflammatory Drugs (NSAID) are top of the list differently from the therapeutic groups list. This is a result of NSAID consintence more than two therapeutic group like analgesics, antiinflammatory and antirheumatic drugs. Common use of NSAID can be a cause of this. Adrenergic inhalers, cold and flu combinations, antacids and antiflatulans and topical corticosteroids are also top lines of the list. Cold and flu combinations, antacids and dermatologics are tend to be quited when symptoms relieved. Antibiotics like cephalosporins and penicillin-beta lactamase combinations had relatively high rate (2,08% and 1,83%, total 3,91%).

Table 21: Value of Therapeutic Groups in TL, 2010

Therapeutic Groups	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Chronic Obstructive Pulmonary Disease Drugs	1.075,60	13,57%	837,14	13,99%
Antiinfectives	919,53	11,60%	758,44	12,68%
Gastrointestinal Drugs	814,69	10,28%	664,03	11,10%
Vitamins and Minerals	643,03	8,11%	130,57	2,18%
Dermatologics	609,57	7,69%	445,88	7,45%
Psychoanaleptic	412,48	5,20%	367,10	6,14%
Cough and Cold Medicines	389,40	4,91%	306,08	5,12%
Various Drugs	386,77	4,88%	297,81	4,98%
Antidepressants	288,07	3,63%	253,39	4,24%
Antihypertensives	268,27	3,38%	248,44	4,15%
Analgesics	250,93	3,17%	209,55	3,50%
Antiinflammatory and Antirheumatic Drugs	223,70	2,82%	177,43	2,97%
Other	1.645,00	20,75%	948,50	21,50%
TOTAL	7.927,03	100,00%	5.982,23	100,00%

In 2010, chronic obstructive pulmonary disease drugs had the biggest rate (13,75% and 13,99%) in both total retail and SGK expenses with the effect of ipratropium bromide unlike relatively low frequency of the group. Antiinfectives (11,60% and 12,68%) and gastrointestinal drugs (10,28% and 11,10%) are second and third line of the both expense list matching with their frequencies. Dermatologics had relatively lower rate in expenditure than frequencies due to their affordable price maybe in 2010.

Table 22: Value of Therapeutic Groups in TL, 2019

Therapeutic Groups	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Chronic Obstructive Pulmonary Disease Drugs	2.000,20	15,14%	1.461,48	17,17%
Antiinfectives	1.437,85	10,88%	1.038,38	12,20%
Gastrointestinal Drugs	1.386,18	10,49%	991,05	11,64%
Dermatologics	1.369,03	10,36%	822,45	9,66%
Vitamins and Minerals	717,06	5,43%	197,16	2,32%
Cough and Cold Medicines	670,71	5,08%	455,82	5,35%
Analgesics	532,52	4,03%	408,14	4,79%
Antiinflammatory and Antirheumatic Drugs	371,55	2,81%	259,30	3,05%
Nasal Drugs	364,79	2,76%	255,69	3,00%
Various Drugs	364,56	2,76%	0,00	0,00%
Antihistaminics	360,51	2,73%	214,88	2,52%
Others	3.636,97	27,53%	2.408,86	28,30%
TOTAL	13.211,93	100,00%	8.513,22	100,00%

Chronic obstructive pulmonary disease drugs (15,14% and 17,17%) were at the top of the list with a small increase again in 2019 expenses. Antiinfectives (10,88% and 12,20%) and gastrointestinal drugs (10,49% and 11,64%) were in the same place of the expense list in 2019. Interestingly, rate of dermatologics has risen to 10,36% and 9,66% in both expenditures. This result shows that these medicines had higher markup in the period.

In a study conducted in Kabul, 46,5% of purchased antibiotics and the remaining purchased NSAIDs, antihypertensive and anti-diabetic medicines in 2017 (91). Results of a study in Mexico in 2014 showed that NSAIDs were the predominant therapeutic group (16 %) found followed by cardiovascular, gastrointestinal and antibacterial drugs (27). In another study from Malta in 2015, cardiovascular and central nervous system medication were the most commonly wasted followed by gastrointestinal and respiratory system. The most commonly wasted medication was from the ‘analgesics’ category (53). Report of a take back event in the United States in 2014, painkillers (15%), antibiotics (6.7%), cardiovascular disease drugs (9.7%), and gastrointestinal drugs and drugs for acne/skin infections (5.2%) were collected as

unused (42). Results of thesis mostly consistent with related studies in therapeutic groups which NSAIDs were the commonest. Also, high range of gastrointestinal drugs, antiinfective and analgesics also run parallel to the studies in the literature. However, cardiovascular drugs mostly seen in studies were not in high rate in this thesis. The difference may be a result of place where the campaign held. The campaign was held in a university which had younger age population in majority. So, chronic cardiovascular disease is not expected common in young population.

4.2.5. ATC Groups

Table 23: Distribution of ATC Groups

ATC Groups	Frequency (n) (box)	Percent (%)
A (Alimentary tract and metabolism)	256	21,32%
R (Respiratory system)	216	17,99%
M (Musculo-skeletal system)	163	13,57%
D (Dermatologicals)	136	11,32%
Unclassified	106	8,83%
N (Nervous system)	105	8,74%
J (Antiinfectives for systemic use)	99	8,24%
C (Cardiovascular system)	41	3,41%
S (Sensory organs)	23	1,92%
B (Blood and blood forming organs)	23	1,92%
P (Antiparasitic products, insecticides, and repellents)	13	1,08%
G (Genito urinary system and sex hormones)	10	0,83%
H (Systemic hormonal preparations, excl. sex hormones and insulins)	7	0,58%
V (Various)	2	0,17%
L (Antineoplastic and immunomodulating agents)	1	0,08%
TOTAL	1201	100,00%

256 Alimentary tract and metabolism drugs, 216 respiratory system and 163 musculo-skeletal system drugs were gathered which had highest frequency rates. Unclassified group were consisted of supplements, veterinary medicines, foreign drugs and unknown. That's why this group had 8,83% rate. It was interesting that there was a drug (azathioprine) in antineoplastic and immunomodulating agents group.

Table 24: Value of ATC Groups in TL, 2010

ATC Groups	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
R	1.814,43	22,89%	1.379,37	23,06%
A	1.424,34	17,97%	958,17	16,02%
J	888,20	11,20%	730,17	12,21%
N	878,67	11,08%	763,13	12,76%
M	665,33	8,39%	552,32	9,23%
D	660,18	8,33%	475,43	7,95%
C	396,88	5,01%	362,94	6,07%
V	391,69	4,94%	302,53	5,06%
Unclassified	310,91	3,92%	27,76	0,46%
G	138,80	1,75%	116,15	1,94%
S	118,09	1,49%	106,32	1,78%
B	100,38	1,27%	82,92	1,39%
L	61,18	0,77%	54,45	0,91%
P	46,10	0,58%	41,42	0,69%
H	31,85	0,40%	29,14	0,49%
TOTAL	7.927,03	100,00%	5.982,23	100,00%

In 2010, as seen in other part, respiratory system drugs (22,89% and 23,06) had highest prices in both expenses. Alimentary tract and metabolism drugs which the commonest in frequency had lower rate in expenses of total retail and SGK. Alimentary tract and metabolism drugs have more affordable prices than respiratory system drugs like ipratropium in general. This can be a factor of lower range. J and N ATC groups also had higher rate in expenses than in frequencies.

Table 25: Value of ATC Groups in TL, 2019

ATC Groups	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
R	3.305,61	25,02%	2.223,98	26,12%
A	2.452,05	18,56%	1.524,98	17,91%
J	1.343,84	10,17%	953,56	11,20%
N	1.029,24	7,79%	750,21	8,81%
M	1.138,93	8,62%	963,19	11,31%
D	1.471,63	11,14%	902,50	10,60%
C	412,18	3,12%	310,85	3,65%
V	373,90	2,83%	9,34	0,11%
Unclassified	687,75	5,21%	79,93	0,94%
G	312,96	2,37%	222,70	2,62%
S	209,09	1,58%	185,61	2,18%
B	202,86	1,54%	156,57	1,84%
L	78,03	0,59%	56,18	0,66%
P	125,17	0,95%	104,90	1,23%
H	68,71	0,52%	68,71	0,81%
TOTAL	13.211,93	100,00%	8.513,22	100,00%

Prices of the group were just about duplicated in 2019 as seen in total retail and SGK expenditure, interestingly. Group sequence was remained same.

ATC sub-groups also added to analysis to detail the subject. There are 63 ATC sub-groups detected among collected medicines in campaign.

Table 26: Distribution of ATC Subgroups

ATC Subgroups	Frequency (n) (box)	Percent (%)
M01 Antiinflammatory And Antirheumatic Drugs	112	9,33%
Unclassified	106	8,83%
J01 Antibacterials For Systemic Use	94	7,83%
A02 Drugs for Acid Related Disorders	76	6,33%
R05 Cough and Cold Preparations	63	5,25%
N02 Analgesics	57	4,75%
R03 Drugs for Obstructive Airway Diseases	55	4,58%
A11 Vitamins	51	4,25%
A03 Drugs for Functional Gastrointestinal Disorders	44	3,66%
R01 Nasal Preparations	43	3,58%
R06 Antihistamines for Systemic Use	35	2,91%
Others	465	38,72%
TOTAL	1201	100,00%

Antiinflammatory and antirheumatic drugs (9,33%) were predominant in the classification. Antibacterials for systemic use (7,83%) drugs for acid related disorders (6,33%) cough and cold preparations (5,25%) and analgesics (4,75%) were also common drugs collected in the campaign. If another unused drug collection campaign would be organized in nowadays, lower rate in collection of antibacterials is expected due to more strict applications of the health authority in Turkey to dispense antibiotics.

Vogler et al published two studies in Austria in 2014 and in 2018. In 2014 results, C group (23,7%), M group (11,2%), N group (10,5%) and A group drugs (9,9%) were the commonest in unused/wasted drugs (73) as not compatible with the result of the thesis. Results of 2018 study showed that the majority were medicines related to A group, N group and R group drugs (44). Studies about returned medicines to pharmacies in New Zealand and Spain also identified most medicines in ATC group A (92,93). In another study in Jordan 2013, alimentary tract drugs (20,7%) was the most commonly encountered followed by nervous system (17,2%) and musculoskeletal (12,9%) drugs wasted (87). The results of the thesis run parallel to majority of the studies in the literature. The difference like having lower C group medicines may be attributed to the demographic characteristics of the population.

4.2.6. Expiration Status

Expiration date of the collected vary from 1982 to 2014. This is amazing that drugs expired 1982 or 1986 were gathered in the campaign. Outstanding year for expiration dates was 2010 but the campaign was organized in 2010 also. In the time of the campaign, 42,67% of drugs with expiration date 2010 were not expired. Varying of distribution was quite high due to not having to check expiration date of the drugs habit as an irrational drug use habit.

Table 27: Distribution of Expiration Date

Year	Frequency (n) (box)	Percent (%)
2010	375	30,49%
2009	248	20,16%
2011	131	10,65%
2008	122	9,92%
Not Known	86	6,99%
2012	82	6,67%
2007	45	3,66%
2006	39	3,17%
2013	18	1,46%
2005	15	1,22%
2004	12	0,98%
2000	12	0,98%
2003	9	0,73%
2014	8	0,65%
2002	6	0,49%
1999	6	0,49%
1998	5	0,41%
2001	4	0,33%
1996	2	0,16%
1995	2	0,16%
1994	1	0,08%
1986	1	0,08%
1982	1	0,08%
TOTAL	1230	100%

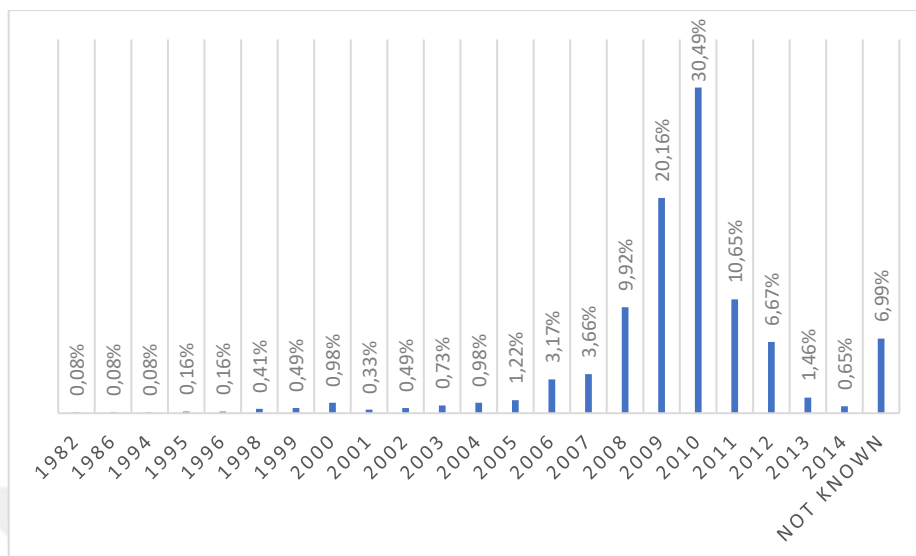


Figure 12: Distribution of Expiration Dates

Table 28: Distribution of Expiration Status

Expiration Status	Frequency (n) (box)	Percent (%)
Expired	731	60,87%
Not Expired	395	32,89%
Not Known	75	6,24%
TOTAL	1201	100,00%

Expired drugs (60,87%) predominate in collected pharmaceutical products. However, 32,89% of drugs are remain not expired also not wanted to store in home by participants. It is a quite high rate than expected. Participants might bring all unused drugs without checking their expiration dates. It is also possible for participants that when a drug became not needed any more, it did not matter whether if it was expired or not. In addition, there were 75 drugs that their expiration date could not be determined.

As more than expected in hypothesis, mean of expiration time among collected items was -10,30 month with standard deviation 38,61. “-” has meaning expired in this calculation. Standard deviation was found quite high due to wide distribution of expiration date (1982 to 2014). So, generalization cannot be made with mean value.

Table 29: Value of Expiration Status in TL, 2010

Expiration Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Expired	4.964,35	62,63%	3.770,97	63,04%
Not Expired	2.846,59	35,91%	2.167,10	36,23%
Not Known	116,09	1,46%	44,15	0,74%
TOTAL	7.927,03	100,00%	5.982,23	100,00%

According to results, expired medicine with the cost 4.964,35 TL wasted in retail price. If these drugs would be reimbursed their cost 3.770,997 TL to the SGK in 2010. Their ranges were similar to their frequencies. On the other hand, medicines with 35,91% in retail expenses and 36,23% in SGK expenses were usable and not expired. It is a chaotic condition why these drugs became unwanted at home and sacrificed as dispose. Also, these drugs remained as unused due to some reasons like self-quitting the therapy, too large package, recovery of the patient etc.

Table 30: Value of Expiration Status in TL, 2019

Expiration Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Expired	7.758,08	58,72%	5.065,26	59,50%
Not Expired	4.927,24	37,29%	3.374,11	39,63%
Not Known	526,61	3,99%	73,86	0,87%
TOTAL	13.211,93	100,00%	8.513,22	100,00%

In 2019, expired medicines (58,72% and 59,50%) are predominated in both price with a slight decrease in range. Surprisingly, cost of drugs with unknown expiration date become more than four times of their cost in 2010.

Table 31: Distribution of Expiration Status in Dosage Forms

Dosage Forms	Expired	Not Expired	Unknown	Total
Tablet				
n (box)	319	194	36	549
Percent (%)	25,93%	15,77%	2,93%	44,63%
Capsule				
n (box)	71	33	5	109
Percent (%)	5,77%	2,68%	0,41%	8,86%
Cream				
n (box)	52	14	2	68
Percent (%)	4,23%	1,14%	0,16%	5,53%
Injectable				
n (box)	51	23	3	77
Percent (%)	4,15%	1,87%	0,24%	6,26%
Pomade				
n (box)	36	5	1	42
Percent (%)	2,93%	0,41%	0,08%	3,41%
Inhaler				
n (box)	26	20		46
Percent (%)	2,11%	1,63%	0,00%	3,74%
Gel				
n (box)	24	4		28
Percent (%)	1,95%	0,33%	0,00%	2,28%
Spray				
n (box)	22	10	1	33
Percent (%)	1,79%	0,81%	0,08%	2,68%
Ointment				
n (box)	20	2	1	23
Percent (%)	1,63%	0,16%	0,08%	1,87%
Solution				
n (box)	20	2	2	24
Percent (%)	1,63%	0,16%	0,16%	1,95%
Dragee				
n (box)	19	20	4	43
Percent (%)	1,54%	1,63%	0,33%	3,50%
Others				
n (box)	91	74	23	188
Percent (%)	7,40%	6,02%	1,87%	15,29%
TOTAL				
n (box)	751	401	78	1230
Percent (%)	61,06%	32,60%	6,34%	100,00%

In general distribution, expired medicines are predominated in oral dosage forms. However, approximately 46% of inhalers and 44% of dragees were not expired

when they were brought to the campaign. Especially, it is thought provoking that usable inhalers which is not expired were wanted to dispose. Therapy cessation or change in therapy might be reasons. Death of a relative might also be a reason. %92 of the solution was expired as more than other dosage forms.

In ATC group distribution, expired predominate as expected. It was unexpected that 1 drug from L ATC group was not expired and brought to the campaign. Around 43% of R ATC group drugs were not expired. It may be due to the effect of high range of inhalers with the same condition. Besides, approximately 18% of C and D ATC group drug were not expired relatively lower than other ATC groups.

Table 32: Distribution of Expiration Status in ATC Groups

ATC Groups	Expired	Not Expired	Unknown	Total
A				
n (box)	152	103	15	270
Percent (%)	12,36%	8,37%	1,22%	21,95%
R				
n (box)	116	93	9	218
Percent (%)	9,43%	7,56%	0,73%	17,72%
M				
n (box)	111	45	11	167
Percent (%)	9,02%	3,66%	0,89%	13,58%
D				
n (box)	109	25	3	137
Percent (%)	8,86%	2,03%	0,24%	11,14%
N				
n (box)	62	40	7	109
Percent (%)	5,04%	3,25%	0,57%	8,86%
Unclassified				
n (box)	59	19	28	106
Percent (%)	4,80%	1,54%	2,28%	8,62%
J				
n (box)	55	42	3	100
Percent (%)	4,47%	3,41%	0,24%	8,13%
C				
n (box)	34	8	1	43
Percent (%)	2,76%	0,65%	0,08%	3,50%
S				
n (box)	14	8	1	23
Percent (%)	1,14%	0,65%	0,08%	1,87%
B				
n (box)	14	9		23
Percent (%)	1,14%	0,73%	0,00%	1,87%
P				
n (box)	9	4		13
Percent (%)	0,73%	0,33%	0,00%	1,06%
G				
n (box)	9	2		11
Percent (%)	0,73%	0,16%	0,00%	0,89%
H				
n (box)	5	2		7
Percent (%)	0,41%	0,16%	0,00%	0,57%
V				
n (box)	2			2
Percent (%)	0,16%	0,00%	0,00%	0,16%
L				
n (box)		1		1
Percent (%)	0,00%	0,08%	0,00%	0,08%
n (box) Total	751	401	78	1230
Percent (%) Total	61,06%	32,60%	6,34%	100,00%

Table 33: Distribution of Expiration Status in Original/Generic/OTC status

Status	Frequency (n) (box)	Percent (%)
Expired	731	60,87%
Generic	323	26,89%
Original	301	25,06%
OTC	50	4,16%
Unknown	26	2,16%
Veterinary	18	1,50%
Other	13	1,08%
Not Expired	395	32,89%
Original	225	18,73%
Generic	137	11,41%
OTC	24	2,00%
Veterinary	6	0,50%
Unknown	2	0,17%
Other	1	0,08%
Unknown	75	6,24%
Original	21	1,75%
OTC	17	1,42%
Generic	16	1,33%
Other	11	0,92%
Unknown	10	0,83%
TOTAL	1201	100,00%

Around 68% of generics and 55% of the original products were expired. 41% of original products not expired became unwanted and brought for disposal to the campaign.

Regarding distribution of unused drugs' expiration date, there are not so many studies in the literature. In a study from Sweden, 51% of medicines returned to pharmacies by customers were expired (94). According to a study in Jordan, 10,9% of the drugs seen had passed the expiration date and 1,8% had an unknown expiration date (87). Another study in the United States found that 66,2% of the unused medicines were expired (42). 41,67% of household medicines had expired medications, according to the result of a study in India (95). In Austria, result of a research showed that 36% of the medicines wasted had not yet expired (44). 60,87% of total collected drugs were expired and 32,89% of them were not expired in the

results of the thesis. The results matched with result of studies held in Austria and the United States but not the others. Nature of population and design of the organization can promote the differences.

4.2.7. Container Status

The term “container” was used to describe the box or other packaging the drugs were enclosed in.

Table 34: Distribution of Container Status

Container Status	Frequency (n) (box)	Percent (%)
With container	766	62,28%
Without container	464	37,72%
TOTAL	1230	100,00%

766 products with container were picked up in the campaign and rest of them did not have container.

Table 35: Value of Container Status in TL, 2010

Container Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
With container	6.025,79	74,53%	4.701,66	76,90%
Without container	2.059,75	25,47%	1.412,29	23,10%
TOTAL	8.085,54	100,00%	6.113,95	100,00%

Drugs with container (74,53% and 76,90%) constituted the majority of both drug expenses in 2010. The cause of this situation can be that drug without container are tended to be consumed more. People mostly discard the container when a few drugs were remained in the package.

Table 36: Value of Container Status in TL, 2019

Container Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
With container	9.987,88	73,84%	6.303,04	72,27%
Without container	3.538,01	26,16%	2.418,09	27,73%
TOTAL	13.525,89	100,00%	8.721,13	100,00%

In 2019, the shares in expenses of drugs with or without container were not changed meaningfully.

In a study in Jordan in 2013, 27,2% of drug products were not in their original containers, 72,8% of them were stored in their original container (87). As another example, during the handling of dosage forms, most of them were still in their original containers (27). Results of the studies run parallel with the thesis.

4.2.8. Price Clipping Status

Price clipping status is an indicator whether the cost of the drugs was absorbed by reimbursement in Turkey. If there are price clipping, the drug dispensed without reimbursement (SGK or private health insurance). Vice versa, if the price clipping does not exist, the cost of drugs was mainly meet by health coverage and minimal charges were paid by the patient which did not count in the thesis.

Table 37: Distribution of Price Clipping Status

Price clipping Status	Frequency (n) (box)	Percent (%)
Without price clipping	889	74,02%
With price clipping	312	25,98%
TOTAL	1201	100,00%

Regarding price clipping, most of the drugs did not have price clipping (74,02%) but it has to be taken in consideration that amounts of drugs without price clipping included drugs without container. Assumptions were made like whole of the drugs in the without price clipping group can be reimbursed. As expected in the hypothesis, people keep reimbursable drugs at home for future use.

Table 38: Value of Price Clipping Status in TL, 2010

Price Clipping Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Without price clipping	6.304,26	79,53%	4.834,31	80,81%
With price clipping	1.622,76	20,47%	1.147,91	19,19%
TOTAL	7.927,03	100,00%	5.982,23	100,00%

In 2010 pricing, retail expense of without price clipping drug were 6.3024,26 TL whereas it formed 80,81% of total SGK expenditure. If it was assumed that all without price clipping drug were reimbursed, financial burden of this waste to SGK (or maybe private health insurance) would be 4.834,31 TL in 2010.

Table 39: Value of Price Clipping Status in TL, 2019

Price Clipping Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Without price clipping	9.980,88	75,54%	6.696,58	78,66%
With price clipping	3.231,04	24,46%	1.816,63	21,34%
TOTAL	13.211,93	100,00%	8.513,22	100,00%

Similar rates were seen expenditures with a slight difference in 2019. Cost of without price clipping drugs (75,54% and 78,66%) predominated in both expenses. If the assumption was made in 2019, financial expenditure of wasted drugs to SGK (or maybe private health insurance) would be 6.696,58 TL in 2019. Price increase in the distribution price clipping status groups were seen as lower than most of other parameters evaluated.

Table 40: Distribution of Original/Generic/OTC status in Price Clipping status

Status	Frequency (n) (box)	Percent (%)
Without Price Clipping	889	74,02%
Original	428	35,64%
Generic	357	29,73%
OTC	59	4,91%
Unknown	25	2,08%
Veterinary	11	0,92%
Other	9	0,75%
With Price Clipping	312	25,98%
Original	119	9,91%
Generic	119	9,91%
OTC	32	2,66%
Other	16	1,33%
Veterinary	13	1,08%
Unknown	13	1,08%
TOTAL	1201	100,00%

428 original drugs were found in without price clipping group which forms 48,15% of the group. There were 40,17% of without price clipping drugs found as generics. The frequency distribution of generic and original drugs in price clipping was correlated with frequency of original and generic status. OTC, veterinary and other products found in this group due to their non-having container condition. Also, some of the OTC could be reimbursed by private health insurance.

Table 41: Distribution of Expiration Status in Price Clipping status

Price Clipping status	Expired	Not Expired	Unknown	Total
With Price Clipping				
n (box)	221	92	6	319
Percent (%)	17,97%	7,48%	0,49%	25,93%
Without Price Clipping				
n (box)	530	309	72	911
Percent (%)	43,09%	25,12%	5,85%	74,07%
n (box) Total	751	401	78	1230
Percent (%) Total	61,06%	32,60%	6,34%	100,00%

58,18% of without price clipping drugs were expired which represents 43,09% of whole collected medicines. 7,90% of the same group had unknown expiration date. This might be connected with mostly their non-having container, too.

To make more accurate calculation related reimbursed and retail cost, container status and prices were added in distribution of the status of price clipping.

Table 42: Distribution of Container Status in Price Clipping status and value (TL), 2010

Status	With container	Without container	Total
Without Price Clipping			
n (box)	451	460	911
Percent (%)	36,67%	37,40%	74,07%
Total retail price (TL)	4.381,97	2.043,37	6.425,33
Total retail price percentage (%)	54,20%	25,27%	79,47%
Total SGK price (TL)	3.527,99	1.412,29	4.940,28
Total SGK price percentage (%)	57,70%	23,10%	80,80%
With Price Clipping			
n (box)	315	4	319
Percent (%)	25,61%	0,33%	25,93%
Total retail price (TL)	1.643,83	16,38	1.660,21
Total retail price percentage (%)	20,33%	0,20%	20,53%
Total SGK price (TL)	1.173,67	-	1.173,67
Total SGK price percentage (%)	19,20%	0,00%	19,20%
n (box) Total	766	464	1230
Percent (%) Total	62,28%	37,72%	100,00%
Total retail price (TL)	6.025,79	2.059,74	8.085,53
Total retail price percentage (%)	74,53%	25,47%	100,00%
Total SGK price (TL)	4.701,66	1.412,29	6.113,95
Total SGK price percentage (%)	76,90%	23,10%	100,00%

According to the calculation, at least 3.527,99 TL (drugs with container and without price clipping) of health coverage expenses were wasted in 2010. There also were unknown additional cost of drugs that did not have price clipping and container both. However, this cost could be maximum 1.412,29 TL in the same year. At the same time, 1.643,83 TL (drugs with container and price clipping both) wasted with retail price at least. Unknown ratio of maximum 2.043,37 TL cost for retail pricing could be added. Due to lack of information about reimbursement status of drugs without container, additional cost could not be calculated.

Table 43: Distribution of Container Status in Price Clipping status and value (TL), 2019

Status	With container	Without container	Total
Without Price Clipping			
n (box)	451	460	911
Percent (%)	36,67%	37,40%	74,07%
Total retail price (TL)	6.659,55	3.538,01	10.197,56
Total retail price percentage (%)	49,24%	26,16%	75,39%
Total SGK price (TL)	4.443,03	2.418,09	6.861,12
Total SGK price percentage (%)	50,95%	27,73%	78,67%
With Price Clipping			
n (box)	315	4	319
Percent (%)	25,61%	0,33%	25,93%
Total retail price (TL)	3.328,33	-	3.328,33
Total retail price percentage (%)	24,61%	0,00%	24,61%
Total SGK price (TL)	1.860,01	-	1.860,01
Total SGK price percentage (%)	21,33%	0,00%	21,33%
n (box) Total	766	464	1230
Percent (%) Total	62,28%	37,72%	100,00%
Total retail price (TL)	9.987,88	3.538,01	13.525,89
Total retail price percentage (%)	73,84%	26,16%	100,00%
Total SGK price (TL)	6.303,04	2.418,09	8.721,13
Total SGK price percentage (%)	72,27%	27,73%	100,00%

Related pricing in 2019, the incremental value of waste charged to SGK was found 4.443,03 TL (drugs with container and without price clipping). Unknown cost was calculated as maximum 2.418,09 TL (drugs without container and price clipping both) for SGK price. Besides, 3.328,33 TL (drugs with container and price clipping both) was wasted as retail price at least and additional retail cost maximum 3.538,01 TL (drugs without container and price clipping both) for retail prices.

In a study from Austria in 2018, the total sample of wasted drugs had a value of €2.987 at reimbursement price and of €4.207 at pharmacy retail price levels among 637 pharmaceutical products recorded in sample (44). Rate in price difference of reimbursement price and retail were seen similar between the literature and the thesis. It is also possible that national applications of each countries can make difference regarding health coverage.

4.2.9. Drug Sample Status

Unexpectedly, there were drug samples among gathered medicines in the campaign. 9,83% of total collected drugs were drug samples.

Table 44: Distribution of Drug Sample Status

Drug Sample Status	Frequency (n) (box)	Percent (%)
Drug Sample	118	9,83%
Not Drug Sample	1083	90,17%
TOTAL	1201	100,00%

Value of drug samples were calculated based on price of the units in the original sizes. SGK price was not calculated due to non-reimbursable condition of drug samples.

Table 45: Value of Drug Sample Status in TL, 2010-2019

Drug Sample Status	2010		2019	
	Retail Price (TL)	Retail Price Percentage (%)	Retail Price (TL)	Retail Price Percentage (%)
Drug Sample	441,09	5,56%	720,99	5,46%
Not Drug Sample	7.485,94	94,44%	12.490,94	94,54%
TOTAL	7.927,03	100,00%	13.211,93	100,00%

5,56% of total retail cost in 2010 and 5,46% of total retail expenses in 2019 were found as drug samples.

Table 46: Distribution of Drug Sample Status in ATC Groups

ATC Group	Drug Sample	Not Drug Sample	Total
M			
n (box)	31	136	167
Percent (%)	2,52%	11,06%	13,58%
A			
n (box)	30	240	270
Percent (%)	2,44%	19,51%	21,95%
D			
n (box)	17	120	137
Percent (%)	1,38%	9,76%	11,14%
Unknown			
n (box)	15	91	106
Percent (%)	1,22%	7,40%	8,62%
R			
n (box)	6	212	218
Percent (%)	0,49%	17,24%	17,72%
N			
n (box)	6	103	109
Percent (%)	0,49%	8,37%	8,86%
C			
n (box)	6	37	43
Percent (%)	0,49%	3,01%	3,50%
J			
n (box)	6	94	100
Percent (%)	0,49%	7,64%	8,13%
B			
n (box)	2	21	23
Percent (%)	0,16%	1,71%	1,87%
S			
n (box)	1	22	23
Percent (%)	0,08%	1,79%	1,87%
H			
n (box)		7	7
Percent (%)	0,00%	0,57%	0,57%
V			
n (box)		2	2
Percent (%)	0,00%	0,16%	0,16%
P			
n (box)		13	13
Percent (%)	0,00%	1,06%	1,06%
G			
n (box)		11	11
Percent (%)	0,00%	0,89%	0,89%
L			
n (box)		1	1
Percent (%)	0,00%	0,08%	0,08%
n (box) Total	120	1110	1230
Percent (%) Total	9,76%	90,24%	100,00%

25,83% of drug samples were from musculo-skeletal system drugs and 25,00% of them were from alimentary tract and metabolism. Frequencies of these groups with drug samples were found similar to frequencies whole distribution of drugs in ATC groups. The rate of respiratory systems in drug samples were 5,00% of total drug samples which is quite lower rate of drugs in ATC groups. This might be due to high rate of ipratropium which was not found in drug samples collected. Holding in faculty of pharmacy can be a reason for unexpected rate of drug samples.

Health care providers' supply of drug samples as seen an opportunity by patients to try therapy. However, results show that this opportunity can turn into waste.

4.2.10. Usage Status

840 drugs were collected as unused and remaining part (30,06%) was never used in the campaign. Mean usage rate were found 66,87% of the total content. It is engrossing that 30,06% of total collected drugs were never used and brought to the campaign for disposal. Hoarding of drugs, inappropriate dispenses and over stock of medicines for future use can be reasons for this.

Table 47: Distribution of Usage Status

Usage Status	Frequency (n) (box)	Percent (%)
Used	840	69,94%
Brand new	361	30,06%
TOTAL	1201	100,00%

Used products predominated in both expenses (52,92% in retail and 53,20% in SGK) in 2010 but percentage of expenses were found much lower than its frequency. Unit based calculation with usage rate could be a reason for the situation. Never used products were %47,08% of retail expenses and 46,80% of SGK expenses which was much higher rate of its frequency on the contrary to used products.

Table 48: Value of Usage Status in TL, 2010

Usage Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Used	4.195,10	52,92%	3.182,51	53,20%
Brand new	3.731,93	47,08%	2.799,72	46,80%
TOTAL	7.927,03	100,00%	5.982,23	100,00%

In 2019, frequency distribution in expenses were found similar. Used drugs were 55,72% of total retail expenditure and 56,88% of total SGK expenditure. The same incompatibility existed in frequency and rate of expenses for 2019 pricing.

Table 49: Value of Usage Status in TL, 2019

Usage Status	Retail Price (TL)	Retail Price Percentage (%)	SGK Price (TL)	SGK Price Percentage (%)
Used	7.361,94	55,72%	4.842,42	56,88%
Brand new	5.849,99	44,28%	3.670,80	43,12%
TOTAL	13.211,93	100,00%	8.513,22	100,00%

Regarding dosage forms, 81,82% of sprays, 80,73% of capsules, 78,57% of pomades, 75,59% of tablets, 75,00% of gel and creams, 69,57% of ointments and 59,36% of syrups were used. As expectancy in the hypothesis, injectable drugs (67,53%) remain mostly unused. Fear of the injection administration, recovery of patient, discontinuation of therapy or relatively small size of injectable drug package (mostly containing one) can be considered as a cause of this.

Table 50: Distribution of Usage Status in Dosage Forms

Dosage Forms	Used	Brand New	Total
Tablet			
n (box)	404	145	549
Percent (%)	32,85%	11,79%	44,63%
Injectable			
n (box)	25	52	77
Percent (%)	2,03%	4,23%	6,26%
Syrup			
n (box)	32	22	54
Percent (%)	2,60%	1,79%	4,39%
Capsule			
n (box)	88	21	109
Percent (%)	7,15%	1,71%	8,86%
Cream			
n (box)	51	17	68
Percent (%)	4,15%	1,38%	5,53%
Suspension			
n (box)	11	9	20
Percent (%)	0,89%	0,73%	1,63%
Pomade			
n (box)	33	9	42
Percent (%)	2,68%	0,73%	3,41%
Gel			
n (box)	21	7	28
Percent (%)	1,71%	0,57%	2,28%
Ointment			
n (box)	16	7	23
Percent (%)	1,30%	0,57%	1,87%
Spray			
n (box)	27	6	33
Percent (%)	2,20%	0,49%	2,68%
Others			
n (box)	152	29	181
Percent (%)	12,36%	2,36%	14,72%
n (box) Total	864	366	1230
Percent (%) Total	70,24%	29,76%	100,00%

In ATC groups, 84,61% of P group (Antiparasitic products, insecticides, and repellents), 78,89% of A group (Alimentary tract and metabolism) and 78,83% of D group (Dermatologicals) were used as the top of lists. As mostly remain unused, 43,48% of B (Blood and blood forming organs), 39,53% of C (Cardiovascular system) and

38,68 of drugs with unknown ATC group were recorded. Irrational drug habits exist in the sample like discontinuation of chronic disease therapies may be a reason for this.

Table 51: Distribution of Usage Status in ATC Groups

ATC Groups	Used	Brand New	Total
A			
n (box)	213	57	270
Percent (%)	17,32%	4,63%	21,95%
R			
n (box)	145	73	218
Percent (%)	11,79%	5,93%	17,72%
D			
n (box)	108	29	137
Percent (%)	8,78%	2,36%	11,14%
N			
n (box)	79	30	109
Percent (%)	6,42%	2,44%	8,86%
Unknown			
n (box)	65	41	106
Percent (%)	5,28%	3,33%	8,62%
J			
n (box)	61	39	100
Percent (%)	4,96%	3,17%	8,13%
C			
n (box)	26	17	43
Percent (%)	2,11%	1,38%	3,50%
S			
n (box)	17	6	23
Percent (%)	1,38%	0,49%	1,87%
B			
n (box)	13	10	23
Percent (%)	1,06%	0,81%	1,87%
P			
n (box)	11	2	13
Percent (%)	0,89%	0,16%	1,06%
G			
n (box)	7	4	11
Percent (%)	0,57%	0,33%	0,89%
H			
n (box)	5	2	7
Percent (%)	0,41%	0,16%	0,57%
L			
n (box)	1	0	1
Percent (%)	0,08%	0,00%	0,08%
n (box) Total	864	366	1230
Percent (%) Total	70,24%	29,76%	100,00%

Most of generic medicines (72,06%) were used and 68,01% of original drugs were kept at home as used. Surprisingly, 58,33% of veterinary drugs remained unused most in this distribution status.

Table 52: Distribution of Usage Status in Original/Generic/OTC status

Status	Used	Brand New	Total
Original	372	175	547
	30,97%	14,57%	45,55%
Generic	343	133	476
	28,56%	11,07%	39,63%
OTC	70	21	91
	5,83%	1,75%	7,58%
Unknown	28	10	38
	2,33%	0,83%	3,16%
Other	17	8	25
	1,42%	0,67%	2,08%
Veterinary	10	14	24
	0,83%	1,17%	2,00%
TOTAL	840 69,94%	361 30,06%	1201 100,00%

According to therapeutic groups, as mostly used groups, 80,95% of analgesics, 79,07% of dermatologic drugs and 75,80% of gastrointestinal drugs were reported which was parallel to ATC groups. On the contrary, 78,18% of chronic obstructive pulmonary disease drugs and 55,00% of antiinflammatory and antirheumatic drugs were recorded as never used. Unused groups were not compatible with ATC group distribution.

Table 53: Distribution of Usage Status in Therapeutic Groups

Therapeutic Groups	Used	Brand New	Total
Chronic Obstructive Pulmonary Disease Drugs			
n (box)	12	43	55
Percent (%)	0,98%	3,50%	4,47%
Antiinfectives			
n (box)	71	40	111
Percent (%)	5,77%	3,25%	9,02%
Gastrointestinal Drugs			
n (box)	119	38	157
Percent (%)	9,67%	3,09%	12,76%
Dermatologics			
n (box)	102	27	129
Percent (%)	8,29%	2,20%	10,49%
Antiinflammatory and Antirheumatic Drugs			
n (box)	18	22	40
Percent (%)	1,46%	1,79%	3,25%
Musculoskeletal System			
n (box)	33	20	53
Percent (%)	2,68%	1,63%	4,31%
Analgesics			
n (box)	85	20	105
Percent (%)	6,91%	1,63%	8,54%
Vitamins and Minerals			
n (box)	69	19	88
Percent (%)	5,61%	1,54%	7,15%
Cough and Cold Medicines			
n (box)	66	17	83
Percent (%)	5,37%	1,38%	6,75%
Antihypertensives			
n (box)	14	15	29
Percent (%)	1,14%	1,22%	2,36%
Others			
n (box)	275	105	380
Percent (%)	22,36%	8,54%	30,90%
n (box) Total	864	366	1230
Percent (%) Total	70,24%	29,76%	100,00%

Regarding usage status, 69,51% of expired drugs and 57,11% of non-expired medicines were recorded as used. Unexpectedly, %9,84 of total collected and 30,18% of non-expired drugs were never used which was usable. Unnecessary stock of dispensed drugs promotes this kind of wastage.

Table 54: Distribution of Usage Status in Expiration Status

Status	Expired	Not Expired	Unknown	Total
Used				
n (box)	522	280	62	864
Percent (%)	42,44%	22,76%	5,04%	70,24%
Brand New				
n (box)	229	121	16	366
Percent (%)	18,62%	9,84%	1,30%	29,76%
n (box) Total	751	401	78	1230
Percent (%) Total	61,06%	32,60%	6,34%	100,00%

Considering of reimbursement status, 74,30% of drugs with price clipping were counted in used group. As reimbursable group, 68,83% of drugs without price clipping were recorded as used. In contrast, 25,71% of drugs with price clipping and 31,17% of reimbursable drugs were never used but dispensed and kept at home.

Table 55: Distribution of Usage Status in Price Clipping Status

Status	Used	Brand New	Total
With Price Clipping			
n (box)	237	82	319
Percent (%)	19,27%	6,67%	25,93%
Without Price Clipping			
n (box)	627	284	911
Percent (%)	50,98%	23,09%	74,07%
n (box) Total	864	366	1230
Percent (%) Total	70,24%	29,76%	100,00%

In a study from Jordan, 15% of total drugs were unused since dispensing (87). A study from Netherlands with oral anti-cancer and biological disease-modifying anti-rheumatic drugs, 71,20% of total therapies were remained unopened (48). 2/3 of dispensed medications were reported unused in a study from USA in 2014 (42). The results of studies were not parallel results of the thesis. Type of organization and therapy group may differentiate the rate of usage.

Results of a study from Findlay (USA) in 2014 showed that there was a trend in the overabundance of unused cardiovascular, gastrointestinal, and analgesic medications in the community (46) as compatible with the thesis.

4.2.11. Foreign Drugs

There were also 39 foreign drugs among the whole collected drugs in the campaign. They were identified by their writing at their packages. 20,51% of these drugs were from Bulgaria and 15,38% of them were from The United States at the top of the list. All foreign drugs form 3,25% of the total collected pharmaceuticals. Their economic analysis could not be made.

Table 56: Distribution of Foreign Drugs by Country

Country	Frequency (n) (box)
Bulgaria	8
USA	6
Germany	5
Canada	4
The United Kingdom	4
Japan	3
Unknown	3
Poland	2
Estonia	1
Denmark	1
France	1
Switzerland	1
TOTAL	39 (3,25% of Total)

4.2.12. Others

When price informations were recording, special conditions were also recorded. The campaign held in 2010 but the analysis was performed in 2019 so some changes related the products occurred.

Table 57: Distribution of Special Status

Special Status	Frequency (n) (box)	Percent (%)
Not special condition	1008	81,95%
Inactive	138	11,22%
Not found	24	1,95%
Not reimbursed anymore	23	1,87%
Not reimbursed anymore/Inactive	22	1,79%
Changed dosage form	3	0,24%
Changed name	9	0,73%
Not exist in market	1	0,08%
Unknown brand name	1	0,08%
Passed to reimbursed	1	0,08%
TOTAL	1230	100,00%

138 of drugs were inactive in 2019. 24 of the products could not found. This group was containing foreign products and unknown products and etc. 23 of them were not reimbursed anymore and 22 were not reimbursed and became inactive in 2019.

5. CONCLUSION

1.230 pharmaceutical products were gathered by 107 participants to the campaign for disposal. The assumption was made that all the drugs were dispensed with retail price or reimbursed price to SGK for the calculation. Their economic burden was 8.086 TL for retail pricing and 6.114 TL for SGK in 2010. In 2019, cost of wasted drugs was found as 13.526 TL and 8.721 TL respectively. The burden was calculated quite high amount even for a study with limited participation rate like just the tip of the iceberg. This is only economic consequences of unused drugs. There are also health related and environmental aspects what can be irreversible.

According to studies mentioned in the thesis, the waste related unused/wasted medication has risen globally. The results of the thesis support the situation by showing cost increase of collected drugs in 9 years.

Education about rational drug use, suitable disposal methods and effects of pharmaceutical to the nature are most important ways to reduce harm related unused/wasted drugs. Lack of written procedure relating safe disposal of wasted pharmaceuticals even in many of the developed countries. Authorities have to take action to reduce the wasted related unused medication and drug wastage. Take back programmes are also a suitable method for collecting unwanted drugs, safe disposal of them and seeing extend of the problem.

To conclude, in the thesis the role of the pharmacist was emphasized again as the most easily accessible health care provider to educate the public. The results cannot be generalized to the public due to the voluntarily participation and not reflecting the public. To improve awareness about the problem, doctors and pharmacists should be educated well enough to educate the public correctly. Most of the irrational use problems can be solved by education. Governments should encourage education to enhance safe use and disposal methods of the pharmaceutical

products and to decrease the negative effects of wastage. Pharmacists are the most accessible to the patient and have an important role to improve awareness related to harm. The incremental cost of unused/wasted drugs can be minimized by collaboration of governments, educators, health care providers and public. By this way, future generation can live in a cleaner world with minimized pharmaceutical waste and economical loss.



6. LIMITATIONS

Voluntary nature of the study, limited number of collected drugs and low participation rates of people in the university to the campaign may restricted the results and the making more accurate predictions. In addition, the distribution of socio-demographic values may be not parallel to that of the general public, or even the university in general, due to the participation being voluntary, and being conducted on a university campus, rather than a selected public area. The data relating to the questionnaire about rational drug use held during the campaign was used in another study.

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8. CURRICULUM VITAE

Personal Informations

Name	Esra	Surname	Çelik
Place of Birth	Istanbul	Date of Birth	24.10.1984
Nationality	Turkey	TR ID Number	18644274466
E-mail	Esracelik1445p@gmail.com	Phone number	00905357304991

Education

Degree	Department	The name of the Institution Graduated From	Graduation year
Master	Clinical Pharmacy	Yeditepe University Institute of Health Sciences	2011
University	Faculty of Pharmacy	Yeditepe University	2008
High school	-	Sabri Çalışkan High School	2002

Languages	Grades
English	Advanced

Work Experience (Sort from present to past)

Position	Institute	Duration (Year - Year)
Patient Safety Supervisor	Bilim Pharmaceuticals	2016-continue
Medical Support Specialist	Bilim Pharmaceuticals	2012-2016
Coordinator of Drug and Poison Consultancy Unit	Yeditepe University	2008-2012

Computer Skills

Program	Level
MS Office	Good
SAP	Average

*Excellent , good, average or basic

Scientific works

Articles published in other journals

Çelik E, Sencan NM, Clark PM. Factors affecting rational drug use (rdu), compliance and wastage. Turkish Journal of Pharmaceutical Sciences. 2013; 10 (1): 151-69.

Journals in the proceedings book of the refereed conference / symposium

Çelik E, Sencan NM, Clark PM. Akılcı ilaç kullanımını etkileyen faktörler üzerine bir diyagram. 22. National Pharmacology Congress. 2013. Antalya, Turkey.
Çelik E, Sencan NM, Altunok EÇ. Akılcı İlaç Kullanımı ve İlaç Kullanım Alışkanlıkları Üzerine Bir Pilot Çalışma. yayın açıklaması. 11st Turkish Pharmacy Congress. 2012. Ankara, Turkey.
Çelik E, Sencan NM, Clark PM. İlaç Bilgi Merkezi: İstanbul'da Gelişen Bir Örnek. ISOPS- 10. 2012. İstanbul, Turkey.

Others (Projects / Certificates / Rewards)

Çelik, E. A pilot study on rational drug use and drug usage habits [dissertation]. İstanbul, Yeditepe University, 2011.
