



Original Article

Biotechnological Drugs Found in Pharmacies in Turkey

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ABSTRACT

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In this study, RxMediapharma® 2017 registered in Turkey was also found in the Ministry of Health aimed to give the public a list of licensed pharmacies biotechnological drugs. Biotechnological drugs were screened using the RxMediapharma® 2017 program. In this study, biotechnological drugs available in pharmacies in Turkey in 2017 and the active substance obtained with biotechnological methods and materials that contain these factors are discussed drugs. Active ingredients were: Abatacept, Abciximab, Adalimumab, Aflibercept, Agalsidase alpha, Agalsidase beta, Aldesleukin, Alteplase, Antihemophilic factor A, Basiliximab, Bevacizumab, Denosumab, Dornoz alfa, Epoetin, Etanercept, Filgrastim, Follitropin alpha, Follitropin beta, Golimumab, Infliximab, Interferons, Ipilimumab, Canakinumab, Urofollitropin alfa, Korean gonadotropin alfa, Laronidase, Lenograstim, Liraglutide, Lutropin alfa, Moroktokog alfa, Natalizumab, Nepidermin, Nanako alfa, Oktokog alfa, Omalizumab, Palivizumab, Panitumumab, Pegfilgrastim, Pegvisomant, Pembrolizumab, Pertuzumab, Ranibizumab, Recombinant factor VIIa, Reteplase, Rituximab, Certolizumab, Cetuximab, Somatotropin, Tenecteplase, Teriparatide, Tocilizumab, Trastuzumab, Ustekinumab, Urofollitropin alfa, Vaccines, Insulin. As a result, in the year 2017, 80 biotechnological active ingredients are detected in pharmacies in Turkey. A total of 132 licensed biotechnological drugs belonging to these ingredients, of which five were native, and 127 were imported, were identified. Also; it was found that the licensed biotechnological group with the largest number of drugs had 32% insulin and the least number of drugs had 1% interleukins.

Keywords: Biotechnology drug, pharmacy, Turkey

1. INTRODUCTION

A Biotechnology is benefiting from the use of biological systems and living organisms to transform or bring products or processes to a specific use. Biotechnology, whose simple applications extend to the first civilizations, has gained a whole new dimension with advances in genetics and molecular biology in recent years¹. Biotechnology; Many areas are used in the field of health, chemical industry, food and agriculture, electronics, mining, paper industry, energy

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field and environmental protection². Today, biotechnological studies in the field of health have made it possible to develop rapidly in drug production. The use of biotechnological medicines is now widespread among traditional medicines³.

Through the production and use of biotechnological drugs;

- Prevention and treatment of diseases will be more effective than conventional treatments,
- The prevention of symptoms of diseases and prevention of diseases,
- Production of more effective and less effective side effects drugs,
- The production of large amounts of human proteins that cannot be found in sufficient quantities,
- The existence of infectious pathogens with the risk of contamination can be eliminated by preventing the use of human and animal resources as raw material⁴.

In this study, based on RxMediapharma® 2017; examined biotechnological drugs found in pharmacies in Turkey in 2017 within the active ingredients, drug indications of these active ingredients, drug pregnancy category and case of domestic and import. Thus, it aimed to understand the importance of place in the number of biotechnological drugs and treatment available in pharmacies in Turkey.

2. MATERIALS AND METHODS

In this study, based on RxMediapharma® 2017 Ministry of Health licensed biotechnological drugs found in pharmacies in Turkey in 2017 scanned and listed according to the case of domestic and imported

3. RESULTS

In this study, insulins, monoclonal antibodies, cytokines, epoetins, blood coagulation factors, plasminogen activators, fusion proteins, vaccines, enzymes, and hormones were screened according to RxMediapharma® 2017 data and the indications of the preparations, active substances of the preparations, pregnancy categories, approved indications were given. Also, active substances and preparations are presented in table form with indications of domestic and imported conditions and pregnancy categories. In the study, 191 active substances were identified, and 83 biotechnological drugs licensed by the Ministry of Health were listed in Table 1-12. According to this result, it has been determined that the licensed biotechnological drug group which has the largest number of drugs is insulins and at least a few of them are interleukins. Also, the percentage of Ministry of Health licensed biotechnological drugs by pharmacological groups and pregnancy categories are given in Figure 1 and 2.

4. DISCUSSION

Biotechnology has a diverse discipline of science (chemistry, biochemistry, genetic engineering, pharmacy, molecular

biology, mathematics, computer engineering, mathematical engineering) Understanding the structure of DNA; recombinant DNA technology, monoclonal antibody technology, hybridoma technology, and gene therapy; new drugs and reliable vaccines have begun to be produced. Increased search for new treatments due to increased diseases such as cancer, AIDS, viral infections has also led to an increase in the trend towards more biotechnological drugs than traditional medicines. Biotechnology applications in health include; new drug delivery systems, new vaccines, formulations and appropriate routes of administration (rDNA), monoclonal antibody technology and the development of future drugs with existing and superior features^{2, 66}. Today, pharmaceutical scientists use biotechnology to understand many disease-related concepts. It also facilitates the treatment of diseases such as diabetes, hemophilia, blood disorders, growth disorders, and cystic fibrosis. Important advantages have also been gained in the development of vaccines using modern biotechnology methods. In particular, the production of hepatitis B vaccines has been started using recombinant DNA technology³. The proportion of biotechnological drugs among the new drugs registered in recent years is increasing. Most of the new drugs developed for the treatment of 200 diseases, including cancer, Alzheimer's, heart diseases, diabetes, and rheumatoid arthritis, constitute biotechnological drugs⁶⁷.

Pharmacists are in charge of pharmacy and hospitals as authorized and responsible for the preparation and distribution of medicines. It is emphasized that pharmacists should be informed about biotechnology products since these products started to enter pharmacies. The use of biotechnological drugs offered to the market in the control of physicians and in the counseling of pharmacists who have been educated in this respect is extremely important in terms of community health. Unconscious use of these drugs can have serious consequences. This study used in pharmacies in Turkey RxMediapharma® maintained under active electronically scanned and recorded using 2017 biotechnological drugs are listed. According to this result, it has been determined that the licensed biotechnological drug group which has the largest number of drugs is insulins and at least a few of them are interleukins. In the framework of the results obtained from this research in the human health field in our country, drug database, which is used to obtain information in performing an effective fight against human diseases (RxMediapharma®) organized by reference to, biotechnological drugs available in pharmacies in Turkey and their active ingredients, indications, pregnancy category of, it is estimated that the physicians will benefit both pharmacists' work when it is considered that the domestic or imported situation is the first work that is given collectively. It is thought that this research may be a source of hope in protecting the health of the community with the future work to be done in this regard.

Table 1: Ministry of Health licensed insulins

Active ingredient	Drug	Local / imported	Pregnancy category	Indications
Insulin Aspart	Novorapid Flacon	Imported	B	Diabetic ketoacidosis, type 1 diabetes, type 2 diabetes ^{5,6,7}
	Novorapid Flexpen	Imported	B	
	Novomix 70/30/50 Flexpen	Imported	B	
	Novomix 30 Penfill	Imported	B	
	Ryzodeg Flextouch	Imported	B	
Insulin Glucine	Apidra Solostar Solution	Imported	C	Diabetic ketoacidosis, type 1 diabetes, type 2 diabetes ^{5,6,7}
Insulin Lispro	Humalog Cartridge	Imported	B	Diabetic ketoacidosis, type 1 diabetes, type 2 diabetes ^{5,6,7}
	Humalog Kwikpen	Imported	B	
	Humalog Flakon	Imported	B	
	Humalog Mix25 Kwikpen	Imported	B	
	Humalog Mix25 Cartridge	Imported	B	
	Humalog Mix50 Cartridge	Imported	B	
	Humalog Mix50 Kwikpen	Imported	B	
Regular Insulin	Actrapid Flack	Imported	B	Diabetic ketoacidosis, Gestational diabetes, Hyperosmolar hyperglycemic status, Type 1 diabetes, Type 2 diabetes ^{5,6,7}
	Actrapid HM Penfill Solution	Imported	B	
	Humulin R Flakon	Imported	B	
	Humulin R Cartridge	Imported	B	
	Humulin M 70/30 Cartridge	Imported	B	
	Mixtard 30 HM Flaken	Imported	B	
	Mixtard 30 HM Cartridge	Imported	B	
Isofuran Insulin	Humulin M 70/30 Cartridge	Imported	B	Gestational diabetes, Type 1 diabetes, type 2 diabetes ^{5,6,7}
	Mixtard 30 HM Flaken	Imported	B	
	Mixtard 3 HM Penfill Cartridge	Imported	B	
Insulin Aspart Protamine	Novomix 70/50/30 Flexpen Suspension	Imported	B	Type 1 diabetes, Type 2 diabetes ^{5,6,7}
	Novomix 30 Penfill Suspension	Imported	B	
Insulin Lispro Protamine	Humalog Injection Mold	Imported	B	Type 1 diabetes, Type 2 diabetes ^{5,6,7}
	Humor Cartridge	Imported		
Insulin	Basaglar	Imported	B	Type 1

Glargine	Kwikpen Pen			diabetes, Type 2 diabetes ^{5,6,7}
	Glarin Pen	Domestic	C	
	Glarin Cartridge	Domestic	C	
	Lantus Solostar Solution	Imported	C	
	Toujeo Solostar Pen	Imported	C	
Insulin Detemir	Levemir Flexpen Solution		B	Diabetic ketoacidosis, Gestational diabetes, Hyperosmolar hyperglycemic status, Type 1 diabetes, Type 2 diabetes ^{5,6,7}
Regular Insulin-Isofuran Insulin Mixture	Humulin Cartridge	Imported	B	Type 2 diabetes ^{5,6,7}
	Mixtard Suspension	Imported	B	
Insulin Aspart-Insulin Aspart Protamine Mixture	Novomix Suspension	Imported	B	Type 1 diabetes, Type 2 diabetes ^{5,6,7}
Insulin Lispro-Insulin Lispro Protamine Mixture	Humalog Injection Mold	Imported	B	Type 1 diabetes, Type 2 diabetes ^{5,6,7}
	Humalog cartridge	Imported	B	

Table 2: Ministry of Health licensed monoclonal antibodies

Active ingredient	Drug	Local / imported	Pregnancy category	Indications
Abciximab	Clotinab Flakon	Imported	C	Acute myocardial infarction, ankylosing spondylitis, myocardial infarction prophylaxis, percutaneous coronary intervention ^{5,6,8}
Adalimumab	Humira Injector, Pen	Imported	B	Rheumatoid arthritis, Crohn's disease, Hidradenitis suppurativa, Ankylosing spondylitis, Polyarticular juvenile idiopathic arthritis, Psoriatic arthritis, Psoriasis, Ulcerative colitis ^{5,6,9}
Basiliximab	Simulect Flachon	Imported	B	Renal transplant rejection prophylaxis ^{5,6,10}
Bevacizumab	Altuzan Vulcan	Imported	C	Glioblastoma multiforme, Colorectal cancer, Non-small cell lung cancer, Renal cell cancer, Cervical cancer ^{5,6,11}

Denosumab	Prolia Injektor	Imported	X	Hypercalcemia, Bone metastases, Osteoporosis, Osteoporosis prophylaxis ^{5,6,12}
	Xgeva Flakon	Imported	D	
Golimumab	Simponi Injektor, Pen	Imported	B	Ankylosing spondylitis, Psoriatic arthritis, Rheumatoid arthritis, Ulcerative colitis ^{5,6,13}
Infliximab	Remicade Flakon	Imported	B	Ankylosing spondylitis, Behçet's syndrome, Crohn's disease, Psoriatic arthritis, Psoriasis, Rheumatoid arthritis, Uveitis, Ulcerative colitis ^{5,6,9}
	Remsima Flakon	Domestic	B	
Ipilimumab	Yervoy Flakon	Imported	C	Malign melanoma ^{5,6,14}
Canakinumab	Ilaris Flakon	Imported	C	Cryopyrin related periodic syndromes ^{5,6}
Natalizumab	Tysabri Flakon	Imported	C	Crohn's disease, Multiple sclerosis ^{5,6,15}
Omalizumab	Xolair Flakon	Imported	B	Chronic idiopathic urticaria ^{5,6,16}
Palivizumab	Synagis Flakon	Imported	C	Respiratory syncytial virus (RSV), Respiratory syncytial virus (RSV) prophylaxis ^{5,6,17}
Panitumumab	Vectibix Flakon	Imported	C	Colorectal cancer ^{5,6,11}
Pembrolizumab	Keytruda Flack	Imported	-	Non-small cell lung cancer Malign melanoma ^{5,6,18}
Pertuzumab	Perjeta Flack	Imported	D	Breast cancer ^{5,6,19}
Ranibizumab	Lucentis Flakon	Imported	C	Macular degeneration ^{5,6,20}
Rituximab	Mabthera Roche Flakon	Imported	C	Chronic lymphocytic leukemia, Non-Hodgkin's lymphoma (NHL), Rheumatoid arthritis, Wegener's granulomatosis ^{5,6,21,22}
Certolizumab Pegol	Cimzia Injektor	Imported	B	Ankylosing spondylitis, Crohn's disease, Psoriatic arthritis, rheumatoid arthritis ^{5,6,23,24}
Cetuximab	Erbix Flakon	Imported	C	Colorectal cancer ^{5,6,25}
Tocilizumab	Actemra Flack	Imported	C	Juvenile rheumatoid arthritis, Rheumatoid arthritis ^{5,6,26}
Trastuzumab	Herceptin Flacon	Imported	D	Breast cancer, Stomach cancer ^{5,6,27,28}
Trastuzumab Emtansine	Kadcyla Flakon	Imported	D	Breast cancer ^{5,6,29}
Ustekinumab	Stelara Injektor	Imported	B	Psoriatic arthritis, Psoriasis ^{5,6,30}

Table 3: Ministry of Health licensed cytokines

Active ingredient	Drug	Local / imported	Pregnancy category	Indications
Lenograstim	Granocyte	Imported	C	Bone marrow transplantation, Chemotherapy-induced neutropenia, Neutropenia, Peripheral blood progenitor cell mobilization ^{5,6,31}
Filgrastim	Fraven Injektor	Domestic	C	Chemotherapy-induced neutropenia, Neutropenia, Peripheral blood stem cell mobilization, Radiation exposure ^{5,6,32}
	Leucostim Injektor	Imported	C	
	Leukoplus Flakon	Imported	C	
	Neupogen Syringe	Imported	C	
	Nivestim Injektor	Imported	C	
	Tevrastam Injektor	Imported	C	
Pegfilgrastim	Neulastim Syringe	Imported	C	Chemotherapy-induced neutropenia ^{5,6,33}

Table 4: Ministry of Health licensed interleukins

Active ingredient	Drug	Local / imported	Pregnancy category	Indications
Aldesleukin	Proleukin Flake	Imported	C	Malignant melanoma, Renal cell carcinoma ^{5,6,34}

Table 5: Ministry of Health licensed interferons

Active ingredient	Drug	Local / imported	Pregnancy category	Indications
Interferon Alfa 2A	Roferon A Roche Syringe	Imported	C	Kaposi's sarcoma, Hepatitis b infection, Hepatitis b virus, Hepatitis c infection, Hepatitis c virus, Chronic myelogenous leukemia (CML), Cutaneous T-cell lymphoma, Malignant melanoma, Multiple myeloma, Non-Hodgkin lymphoma (NHL) Thrombocytosis, Follicular leukemia ^{5,6,35}
Interferon Alfa 2B	Solution to Intron	Imported	C	West Nile virus, West Nile virus infection, Kaposi's sarcoma, St. Louis encephalitis virus, St. Louis encephalitis, St. Hepatitis c virus, Hepatitis c

				virus, Hepatitis d virus, Herpes simplex virus type 1, Herpes simplex virus type 2, Hypereosinophilic syndrome, Human T-cell leukemia virus infection, Adenovirus, Encephalomyocarditis virus, Hemangioma, Hepatitis b infection, Hepatitis b virus, Hepatitis b virus, lymphoma virus type 1 (HTLV-I), Human immunodeficiency virus (HIV), Human papillomavirus (HPV), Condyloma acuminata, Coronavirus, Chronic myelogenous leukemia (CML), Malignant melanoma, Bladder cancer, Multiple myeloma, Non-hodgkin lymphoma NHL), Over cancer, Polio virus (polio virus), Renal cell carcinoma, Rhinovirus, Hairy cell leukemia, Varicella zoster virus, Vesicular stomatitis virus, Flower virus (variola virus) 5,6,36
Peginterferon Alfa 2A	Pegasys Roche Syringe	Imported	C	Hepatitis b encefusion, Hepatitis b virus, Hepatitis c infection, Hepatitis c virus, Hepatitis d virus 5,6,37
Peginterferon Alfa 2B	Pegintron Solution	Imported	C	Adenovirus, Encephalomyocarditis virus, Hepatitis B infection, Hepatitis B virus, Hepatitis C infection, Hepatitis C virus, Hepatitis D virus, Herpes Simplex Virus Type 1, Herpes Simplex Virus Type 2, Human T-Lymphocyte Virus Type I (Htlv- Human Papillomavirus

				(Hpv), Coronavirus, Malin Melanoma, Poliovirus, Rinovirus, Varicella-Zoster Virus, Vesicular Stomatitis Virus, Flower Virus (Variola Virus), Human Immunodeficiency Virus (HIV) 5,6,36
Interferon Beta 1A	Avonex Solution	Imported	C	Multiple Sclerosis 5,6,38
	Rebif Solution	Imported	C	
Interferon Beta 1B	Betaferon Vaccine	Imported	C	Multiple Sclerosis 5,6

Table 6: Ministry of Health licensed epoetins

Active ingredient	Drug	Local / imported	Pregnancy category	Indications
Darbepoetin Alfa	Aranesp Solution	Imported	C	Anemia 5,6,39
Epoetin Alfa	Dropoetin Syringe	Domestic	C	Anemia 5,6,40
	Epoplus Flacon	Imported	C	
	Eporon Injector	Imported	C	
	Eprex Syringe	Imported	C	
Epoetin Beta	Neorecormon Syringe	Imported	C	Anemia 5,6,41
Epoetin Beta Methoxypolyethylene Glycol	Mircera Syringe	Imported	C	Anemia 5,6,42
Epoetin Zeta	Ebel Injector	Imported	-	Anemia 5,6,43

Table 7: Ministry of Health licensed blood coagulation factors

Active ingredient	Drug	Local/ imported	Pregnancy category	Indications
Antihemophilic Factor A	Hemophila Flacon	Imported	C	Hemorrhoids, Haemophilia A, Hemorrhage, Hemorrhage prophylaxis, von Willebrand disease 5,6,44
Octocog Alpha	Advate Flakon	Imported	C	Surgical bleeding prophylaxis, Hemarthrosis, Hemophilia A, Hemorrhage, Hemorrhagic prophylaxis, von Willebrand disease 5,6,45
	Kogenate Bayer Flachon	Imported	C	
	Kogenate FS Vaccine	Imported	C	
	Recombinant Flacon	Imported	C	
Moroktocog Alfa	Refacto AF Powder + Solvent	Imported	C	Surgical Hemorrhage, Hemarthrosis, Hemophilia A, Hemorrhage, Bleeding Prophylaxis, Von Willebrand's

Nonacog Alfa	Benefit Powder + Solvent	Imported	C	Disease ^{5,6,46} Surgical bleeding, Hemarthrosis (intraarticular hemorrhage), Hemophilia B, Hemorrhage, Bleeding prophylaxis ^{5,6,47}
Recombinant Factor VIIa	Novoseven Flakon	Imported	C	Glanzmann thrombasthenia, Factor VII deficiency, Hemophilia A, Haemophilia B, Acquired blood factor deficiency ^{5,6,48}

Table 8: Ministry of Health licensed plasminogen activators

Active ingredient	Drug	Local/imported	Pregnancy category	Indications
Alteplase	Actilyse Flakon	Imported	C	Acute myocardial infarction, involuntary stroke, coronary artery thrombosis, pulmonary embolism ^{5,6,49}
Reteplase	Rapilysin Flaken	Imported	C	Acute myocardial infarction, Coronary artery thrombosis ^{5,6,50}
Tenecteplase	Metalyse	Imported	C	Acute myocardial infarction, Coronary artery thrombosis ^{5,6,51}

Table 9: Ministry of Health licensed fusion proteins

Active ingredient	Drug	Local/imported	Pregnancy category	Indications
Abatacept	Orencia Flack	Imported	C	Polyarticular juvenile idiopathic arthritis, Rheumatoid arthritis ^{5,6,52}
	Orencia Syringe	Imported	C	
Aflibercept	Eylea Flakon	Imported	C	Diabetic macular edema, Diabetic retinopathy, Macular degeneration, Macular edema after retinal venacular occlusion ^{5,6,53}
	Zaltrap Fleakon	Imported	-	
Etanercept	Enbrel Powder	Imported	B	Ankylosing spondylitis, Juvenile rheumatoid arthritis, Psoriatic arthritis, Psoriasis, Rheumatoid arthritis ^{5,6,54}
	Enbrel Mycolic Pen	Imported	B	
	Enbrel Injector	Imported	B	

Table 10: Ministry of Health licensed vaccinations

Active ingredient	Drug	Local/imported	Pregnancy category	Indications
Hepatitis B vaccine	Engerix Adult/ Pediatric Injector	Imported	C	Hepatitis B prophylaxis ^{5,6}
	Hbvaxpro Adult/ Pediatric Flakon	Imported	C	
	H-Vac Adult Bulb	Imported	C	
Combined Hepatitis A and B Vaccine	Twinrix Injector	Imported	C	Hepatitis A prophylaxis, Hepatitis B prophylaxis ^{5,6}
DTaB, Hepatitis B, Poliovirus, Hib Conjugate Vaccine	Hexaxim Injector	Imported	-	Diphtheria prophylaxis, Diphtheria prophylaxis, Hepatitis B prophylaxis, Tetanus prophylaxis ^{5,6}
	Infarix Hexa Injector	Imported	-	
Human Papilloma Virus Vaccine Bivalent	Cervarix Injector	Imported	C	Human papillomavirus (HPV) infection prophylaxis ^{5,6}
Human Papilloma Virus Vaccine Tetravalent	Gardasil Recombinant Vaccine	Imported	B	Human papillomavirus (HPV) infection prophylaxis ^{5,6}

Table 11: Ministry of Health licensed enzymes

Active ingredient	Drug	Local/imported	Pregnancy category	Indications
Agalsidase Alfa	Replagal Flachon	Imported	-	Fabry Disease ^{5,6,55}
Agalsidase Beta	Fabrazyme Powder	Imported	B	Fabry Disease ^{5,6,56}
Dorsal Alfa	Pulmozyme Solution	Imported	B	Cystic fibrosis, Mucolysis ^{5,6}
Leonidas	Aldurazyme Solution	Imported	B	Mucopolysaccharidosis I ^{5,6,57}

Table 12: Ministry of Health licensed hormones

Active ingredient	Drug	Local/imported	Pregnancy category	Indications
Follitropin Alpha	Gonal-F Pen	Imported	X	Hypogonadism, Infertility (infertility), Oligospermia ^{5,6,58}
	Gonal-F Powder + Solvent	Imported	X	
Follitropin Beta	Puregon Cartridge	Imported	X	Hypogonadism, Infertility (infertility), Oligospermia ^{5,6,58}
Corifollitropin Alfa	Elona Solution	Imported	-	Infertility (infertility), Over failure ^{5,6,59}
Lutropin Alfa	Luveris Powder + Solution	Imported	X	Infertility (infertility) ^{5,6,60}
Chorionic	Ovitrelle Solution	Imported	X	Hypogonadism, Infertility

Gonadotropin Alfa				(Infertility), Cryptorchidism, Oligospermia ^{5,6}
Glucagon Hydrochloride	Glucagon Hypocrite	Imported	B	Beta-blocker toxicity, Hypoglycemia, Radiographic examination, Verapamil toxicity ^{5,6}
Liraglutide	Victoza Solution	Imported	C	Obesity, Type II Diabetes ^{5,6,61}
Nepidermin	Heberprot-P Flakon	Imported	-	Diabetic foot care ^{5,6,62}
	Regen-D Gel	Imported	-	
Pegvisomant	Somavert Flachon	Imported	B	Acromegaly ^{5,6,63}
Somatotropin	Genotropin Go quick Pen	Imported	C	Down syndrome, Noonan syndrome, Prader-Willi syndrome, SHOX (short length homeobox-containing gene) deficiency, Turner's syndrome, Growth retardation, Growth hormone deficiency, Cachexia, Short bowel syndrome ^{5,6,64}
	Humatrope Cartridge	Imported	C	
	Norditropin Simplex Cartridge	Imported	C	
	Omnitrope Cartridge	Imported	C	
	Saizen Click Dust + Solvent	Imported	C	
Teriparatide	Faster Solution	Imported	C	Hypoparathyroidism, Osteoporosis ^{5,6,65}

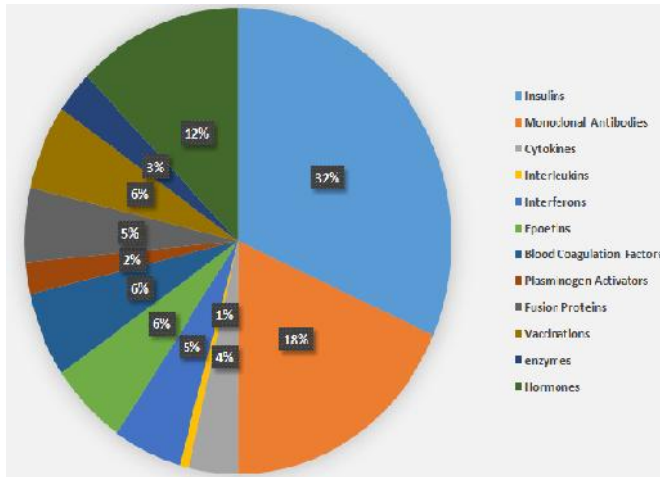


Fig 1: Percentage of biotechnological drugs by pharmacological groups

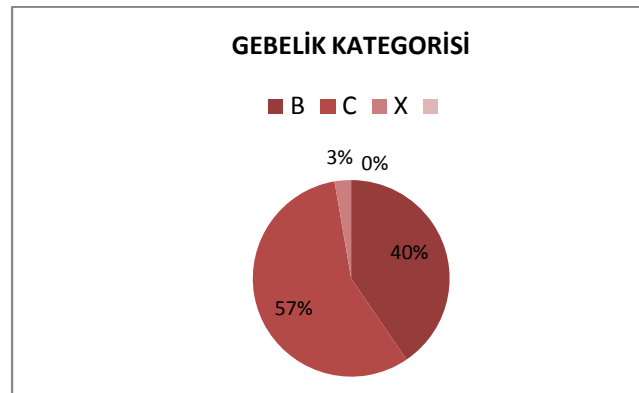


Fig 2: Percentage of biotechnological drugs by pregnancy categories

5. ACKNOWLEDGEMENT

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6. REFERENCES

- Öktem H. Yeni Nesil Transgenikler, 6. Ankara Biyoteknoloji Günleri: Biyoteknoloji, Biyogüvenlik ve Sosyoekonomik Yaklaşımlar, Ankara.2007; 31- 45.
- Tamer S, Degim I. Biyoteknolojik ilaçlar, Genel Bakı . Türkiye Klinikleri J Pharm Sci2016; 5: 77
- Gül Ü. Sağlık Alanında Biyoteknolojik Uygulamalar: Kırmızı Biyoteknoloji. Bilecik Eylül Edebiyatı Üni Fen Bil Derg 2014; 1(1): 67-68
- Andırın M. Biyoteknoloji. ADEOB 2004; 17-19
- RxMediapharma® 2017
- Kayaalp O. Tıbbi farmakoloji. Hacettepe, Ankara, 1996.
- Karakoc A, Konca C. Diabetes Mellitus'ta insülin Tedavisi. MISED Derg 2010; 23-24: 14-18
- Atalar E, Tokgözoğlu L. Akut Koroner Sendromlarda Glikoprotein IIb/IIIa Reseptör Blokerlerinin Kullanımı. Yoğun Bakım Dergisi 2001; 2: 122-128.
- Pay S. Romatizmal Hastalıklarda Anti-TNF ilaç Kullanımı. Türkiye Klinikleri J Med Sci 2006, 26:430-440
- Turkmen A. Transplantasyon Nefrolojisi Pratik Uygulama Önerileri. 2016.
- Sakalar C, İzgi K, Canatan H. Kanser İmmün Terapi ve Monoklonal Antikorlar. F.Ü.Sa. Bil. Tıp Derg. 2013; 27: 105 – 110.
- Kulaksızoğlu M. Osteoporoz Tedavisinde Denosumab. Türkiye Klinikleri J Endocrin- Special Topics 2017; 10: 95-100.
- Durmuş B. Yeni Anti- TNF'ler : Golimumab ve Sertolizumab Pegol. Türkiye Klinikleri J PM&R- Special Topics 2014; 7: 81-87.
- Aslan F, Oksuzoğlu OB, Yıldız F, Kanmaz H, Bugdaycı Basal F et al. Experience One Center Of Ipilimumab in Metastatic Malign Melanoma. Anta Oncol Turc 2017;242-243.

15. Kurtuncu M. Natalizumab Treatment in Multiple Sclerosis. *Archives of Neuropsychiatry* 2011; 48: 56-60.
16. Akyol A, Oktem A, Akay BN, Kundakci N, Boyvat A. Omalizumab and treatment-resistant chronic spontaneous urticaria. *Türkderm* 2015; 49: 180-3.
17. Yalaz M, Kultursay N. Respiratuar sinsisyal virus enfeksiyonu ve riskli bebeklerde palivizumab profilaksisi. *Çocuk Sa lı ı ve Hastalıkları Dergisi* 2014; 57: 200-213.
18. Altundag O. Advances in the Immunotherapy of Lung Cancer. *Turkiye Klinikleri J Med Oncol- Special Topics* 2017; 10: 149-155.
19. Sandra MS, José B, Sung-Bae K, Jungsil R, Vladimir S, et al. Pertuzumab, Trastuzumab, and Docetaxel in HER2-Positive Metastatic Breast Cancer. *N Engl J Med* 2015;372:724-34.
20. Rosenfeld PJ, Brown DM, Heier JS, Boyer DS, Kaiser PK, et al. Ranibizumab for Neovascular Age-Related Macular Degeneration. *N Engl J Med* 2006;355:1419-31.
21. Plosker GL, Figgitt DP. Rituximab - A Review of its Use in Non-Hodgkin's Lymphoma and Chronic Lymphocytic Leukaemia. *Drugs* 2003; 63 (8): 803-843.
22. De Vita S, Quartuccio L. Treatment of rheumatoid arthritis with rituximab: An update and possible indications. *Autoimmunity Reviews* 2006; 5: 443-448
23. Sandborn WJ, Feagan BG, Stoinov S, Honiball PJ, Rutgeerts P, et al. Certolizumab Pegol for the Treatment of Crohn's Disease. *N Engl J Med* 2007;357:228-38.
24. Smolen J, Landewe' RB, Mease P, Brzezicki J, Mason D, Lujtens K, et al. Efficacy and safety of certolizumab pegol plus methotrexate in active rheumatoid arthritis: the RAPID 2 study. A randomized controlled trial. *Ann Rheum Dis* 2009;68:797-804.
25. Cunningham D, Humblet Y, Siena S, Khayat D, Bleiberg H, et al. Cetuximab Monotherapy and Cetuximab plus Irinotecan in Irinotecan-Refractory Metastatic Colorectal Cancer. *N Engl J Med* 2004;351:337-45.
26. Oldfield V, Dhillon S, Plosker GL. Tocilizumab - A Review of its Use in the Management of Rheumatoid Arthritis. *Drugs* 2009; 69: 609-632
27. Radzikowska E, Szczepanski E, Chabowski M, Bistry I. Organising pneumonia caused by trastuzumab (Herceptin) therapy for breast cancer. *Eur Respir J* 2003; 21: 552-555
28. De Mello RA, Marques AM, Araújo A. HER2 therapies and gastric cancer: A step forward. *World J Gastroenterol* 2013 October 7; 19: 6165-6169.
29. Verma S, Miles D, Gianni L, Krop IE, Welslau M, et al. Trastuzumab Emtansine for HER2-Positive Advanced Breast Cancer. *N Engl J Med* 2012;367:1783-91.
30. Griffiths CEM, Strober BE, Van de Kerkhof P, Ho V, Fidelus-Gort R, et al. Comparison of Ustekinumab and Etanercept for Moderate-to-Severe Psoriasis. *N Engl J Med* 2010;362:118-28.
31. Keating GM. Lenograstim - A Review of its Use in Chemotherapy-Induced Neutropenia, for Acceleration of Neutrophil Recovery Following Haematopoietic Stem Cell Transplantation and in Peripheral Blood Stem Cell Mobilization. *Drugs* 2011; 71: 679-707.
32. Frampton JE, Lee CR, Faulds D. Filgrastim - A Review of its Pharmacological Properties and Therapeutic Efficacy in Neutropenia. *Drugs* 48 (5): 731-760, 1994
33. Curran MP, Goa KL. Pegfilgrastim. *Drugs* 2002; 62 (8): 1207-1213
34. Jeal W, Goa KL. Aldesleukin (Recombinant Interleukin-2) - A Review of its Pharmacological Properties, Clinical Efficacy, and Tolerability in Patients with Renal Cell Carcinoma. *BioDrugs* 1997; 7 : 285-317
35. Misiani R, Bellavita P, Fenili D, Vicari O, Marchesi D, et al. Interferon Alfa-2a Therapy in Cryoglobulinemia Associated with Hepatitis C Virus. *N Engl J Med* 1994; 330: 751-756.
36. Manns MP, McHutchison JG, Gordon, Rustgi VK, Shiffman M, et al. Peginterferon alfa-2b plus ribavirin compared with interferon alfa-2b plus ribavirin for initial treatment of chronic hepatitis C: a randomized trial. *The Lancet* 2001; 358: 958-965.
37. Fried MW, Shiffman ML, Reddy KR, Smith C, Marinos G, et al. Peginterferon alfa-2a plus ribavirin for chronic hepatitis C virus infection. *New England Journal of Medicine* 2002; 347: 975-982.
38. Jacobs LD, Cookfair DL, Rudick RA, Herndon RM, Richert JR, et al. Intramuscular interferon beta-1a for disease progression in relapsing multiple sclerosis. *Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society* 1996; 39: 285-294.
39. Swedberg K, Young JB, Anand IS, Cheng S, Desai AS, et al. Treatment of Anemia with Darbepoetin Alfa in Systolic Heart Failure. *N Engl J Med* 2013;368:1210-9.
40. Singh AK, Szczech L, Tang KL, Barnhart H, Sapp S, et al. Correction of Anemia with Epoetin Alfa in Chronic Kidney Disease. *N Engl J Med* 2006;355:2085-98.
41. Hedenus M, Birgega G, Nasman P, Ahlberg L, Karlsson T. Addition of intravenous iron to epoetin beta increases hemoglobin response and decreases epoetin dose requirement in anemic patients with lymphoproliferative malignancies: a randomized multicenter study. *Leukemia* 2007; 21: 627-632.
42. Sánchez-Fructuoso A, Guirado L, Ruiz JC, Torregrosa V, González E, et al. Anemia Control in Kidney Transplant Patients Treated With Methoxy Polyethylene Glycol-Epoetin Beta (Mircera): The Anemiatrans Group. *Transplantation Proceedings* 2010; 42: 2931-2934.

43. Baldamus C, Krivoshev S, Wolf-Pflugmann M, Koytchev R. Long-Term Safety and Tolerability of Epoetin Zeta, Administered Intravenously, for maintenance treatment of Renal Anemia. *Adv Ther.* 2008;25:1215-1228.
44. Schwartz RS, Abildgaard CF, Aledort LM, Arkin S, Bloom AL, et al. Human recombinant DNA-derived antihemophilic factor (factor VIII) in the treatment of hemophilia A. *New England Journal of Medicine* 1990; 323: 1800-1805.
45. Shapiro AD. Anti-hemophilic factor (recombinant), plasma/ albumin-free method (octocog-alpha; ADVATE®) in the management of hemophilia A. *Vascular Health and Risk Management* 2007; 3: 555-565.
46. RECHT M, NEMES L, MATYSIAK M, MANCO-JOHNSON BLUSHER J, et al. Clinical evaluation of moroctocog alfa (AF-CC), a new generation of B-domain deleted recombinant factor VIII (BDDrFVIII) for treatment of hemophilia A: demonstration of safety, efficacy, and pharmacokinetic equivalence to full-length recombinant factor VIII. *Haemophilia* 2009; 15: 869-880.
47. Hartmann J, Croteau SE. 2017 Clinical trials update Innovations in hemophilia therapy. *American Journal of Hematology* 2016; 91: 1252-1260.
48. Hay CRM, Negrier C, Ludlam CA. The treatment of bleeding in acquired hemophilia with recombinant factor VIIa: a multicentre study. *Thrombosis and hemostasis* 1997; 78: 1463-1467.
49. Hacke W, Kaste M, Bluhmki E, Brozman M, Dávalos A, et al. Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke. *N Engl J Med* 2008;359:1317-29.
50. Noble S, McTavish D. Reteplase - A Review of its Pharmacological Properties and Clinical Efficacy in the Management of Acute Myocardial Infarction. *Drugs* 1996; 52: 589-605
51. Davydov L, Cheng JWM. Tenecteplase: A Review. *Clinical Therapeutics* 2001; 23: 982-997.
52. Genovese MC, Becker JC, Schiff M, Luggen M, Sherrer Y, et al. Abatacept for rheumatoid arthritis refractory to tumor necrosis factor inhibition. *New England Journal of Medicine* 2005; 353: 1114-1123.
53. Korobelnik JF, Do DV, Schmidt-Erfurth U, Boyer DS, Holz FG, et al. Intravitreal aflibercept for diabetic macular edema. *Ophthalmology* 2014; 121: 2247-2254.
54. Mease PJ, Kivitz AJ, Burch FX, Siegel EL, Cohen SB, et al. Etanercept treatment of psoriatic arthritis: safety, efficacy, and effect on disease progression. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology* 2004; 50: 2264-2272.
55. Beck M, Ricci R, Widmer U, Dehout F, De Lorenzo AG, et al. Fabry disease: overall effects of agalsidase alfa treatment. *European journal of clinical investigation* 2004; 34: 838-844.
56. Banikazemi M, Bultas J, Waldek S, Wilcox WR, Whitley CB, et al. Agalsidase-beta therapy for advanced Fabry disease: a randomized trial. *Annals of internal medicine* 2007; 146:77-86.
57. Clarke LA, Wraith JE, Beck M, Kolodny EH, Pastores GM, et al. Long-term efficacy and safety of laronidase in the treatment of mucopolysaccharidosis I. *Pediatrics* 2009; 123: 229-240.
58. Harlin J, Csemiczky G, Wramsby H, Fried G. Recombinant follicle stimulating a hormone in in-vitro fertilization treatment—clinical experience with follitropin alpha and follitropin beta. *Human Reproduction* 2000; 15: 239-244.
59. Loutradis D, Drakakis P, Vlismas A, Antsaklis A. Corifollitropin alfa, a long-acting follicle-stimulating hormone agonist for the treatment of infertility. *Current opinion in investigational drugs (London, England: 2000)* 2009; 10: 372-380.
60. Dhillon S, Keating GM. Lutropin Alfa. *Drugs* 2008; 68 : 1529-1540
61. Pi-Sunyer X, Astrup A, Fujioka K, Greenway F, Halpern A, et al. A randomized, controlled trial of 3.0 mg of liraglutide in weight management. *New England Journal of Medicine* 2015; 373: 11-22.
62. Lau HC, Kim A. Pharmaceutical perspectives of impaired wound healing in diabetic foot ulcer. *Journal of Pharmaceutical Investigation* 2016; 46: 403-23
63. Trainer PJ, Drake WM, Katznelson L, Freda PU, Herman-Bonert V, et al. Treatment of acromegaly with the growth hormone-receptor antagonist pegvisomant. *New England Journal of Medicine* 2000; 342: 1171-1177
64. Reh CS, Geffner ME. Somatotropin in the treatment of growth hormone deficiency and Turner syndrome in pediatric patients: a review. *Clinical Pharmacology: Advances and Applications* 2010; 2: 111-122.
65. Saag KG, Shane E, Boonen S, Marín F, Donley DW, et al. Teriparatide or alendronate in glucocorticoid-induced osteoporosis. *New England Journal of Medicine* 2007; 357: 2028-2039.
66. Memis S, Aslankut B. Biyoekonomi: Biyoteknoloji Sektörel Novasyon Sistemi (1), Mahmut Kiper, Afsar Matbaacılık, Ankara, 2013.
67. IEIS. Biyoteknolojik ilaçlar kitapçığı. 2016.

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