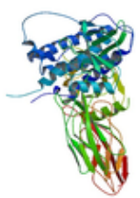
Identification	
Name	**Erythropoietin**
Accession Number	**DB00016** (BTD00103, BIOD00103, DB08923)
Type	Biotech
Groups	Approved
Description	Erythropoietin is a 165-amino acid erythropoiesis-stimulating glycoprotein manufactured by recombinant DNA technology. It has a molecular weight of approximately 30,400 daltons and is produced by mammalian cells into which the human erythropoietin gene has been introduced. The product contains the identical amino acid sequence of isolated natural erythropoietin.
Protein structure	 (//s3-us-west-2.amazonaws.com/drugbank/protein_structures/full/DB00016.png?1266600386)
Related Articles	Neuromedin U Peptide Activates STAT5 and S6 in a JAK-2 Dependent Manner and Promotes Erythroid Cell Growth in Primary Erythroid Progenitor Cells Rebecca Lenzo et al., Blood, 2012 The dominant negative β isoform of the glucocorticoid receptor is uniquely expressed in erythroid cells expanded from polycythemia vera patients. Lilian Varricchio et al., Blood, 2011 Erythropoietin Induces Tyrosine Phosphorylation of Jak2, STAT5A, and STAT5B in Primary Cultured Human Erythroid Precursors Atsushi Oda et al., Blood, 1998 The Jak-Stat pathway in normal and perturbed hematopoiesis Alister C. Ward et al., Blood, 2000 Powered by
Protein chemical formula	$C_{815}H_{1317}N_{233}O_{241}S_5$
Protein average weight	18396.1 Da

Sequences

```
>DB00016 (Erythropoietin) sequence
APPRLICDSRVLERYLLEAKEAENITTGCAEHCSLNENITVPDTKVNFYAWKRMEVGQQA
VEVWQGLALLSEAVLRGQALLVNSSQPWEPLQLHVDKAVSGLRSLTTLLRALGAQKEAIS
PPDAASAAPLRTITADTFRKLFRVYSNFLRGKLKLYTGEACRTGDR
```

Download FASTA Format (/drugs/DB00016/polypeptide_sequences.fasta)

Synonyms

E.P.O.
Epoetin alfa
Epoetin alfa rDNA
Epoetin alfa, recombinant
Epoetin beta
Epoetin beta rDNA
Epoetin epsilon
Epoetin gamma
Epoetin gamma rDNA
Epoetin kappa
Epoetin omega
Epoetin theta
Epoetin zeta
Epoetina dseta
Epoétine zêta
Epoetinum zeta
Erythropoiesis stimulating factor
Erythropoietin (human, recombinant)
Erythropoietin (recombinant human)
ESF
SH-polypeptide-72

External IDs	BM 06.019
Product Ingredients	Not Available

Approved Prescription Products

Show 10 entries Search

Name	Dosage	Strength	Route	Labeller	Marketing Start	Marketing End		
Abseamed	Injection, solution	9000 IU/0.9ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	6000 IU/0.6ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	30000 IU/0.75ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	5000 IU/0.5ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	20000 IU/0.5ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	4000 IU/0.4ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	9000 IU/0.9ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	3000 IU/0.3ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	2000 IU/1.0ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		
Abseamed	Injection, solution	10000 IU/1.0ml	Intravenous; Subcutaneous	Medice Arzneimittel Pütter Gmb H & Co. Kg	2007-08-28	Not applicable		

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Approved Generic Prescription Products	Not Available
Approved Over the Counter Products	Not Available
Unapproved/Other Products	Not Available

International Brands

Show 10 entries Search

Name	Company
Binocrit	Sandoz
Epobel	Nobel Ilac Pazarlama ve Sanayii Ltd. STI., Turkey
Epocept	Lupin pharma
Epofit	Intas pharma
Epogin	Chugai
Eqralys	Hemofarm AD
Nanokine	Nanogen Pharmaceutical biotechnology, Vietnam)
Retacrit	Hospira, Inc.
Silapo	Cell Pharm GmbH

Showing 1 to 9 of 9 entries Previous 1 Next

Brand mixtures

Not Available

Categories

- Amino Acids, Peptides, and Proteins (/categories/DBCAT000021)
- Antianemic Preparations (/categories/DBCAT002099)
- Biological Factors (/categories/DBCAT000036)
- Blood and Blood Forming Organs (/categories/DBCAT002085)
- Carbohydrates (/categories/DBCAT000085)
- Colony-Stimulating Factors (/categories/DBCAT000082)
- Cytokines (/categories/DBCAT000079)
- Erythropoiesis-Stimulating Agents (/categories/DBCAT002721)
- Erythropoietin (/categories/DBCAT000081)
- Glycoconjugates (/categories/DBCAT000084)
- Glycoproteins (/categories/DBCAT000083)
- Hematinics (/categories/DBCAT000087)
- Hematologic Agents (/categories/DBCAT000008)
- Hematopoietic Cell Growth Factors (/categories/DBCAT000086)
- Intercellular Signaling Peptides and Proteins (/categories/DBCAT000080)
- Peptides (/categories/DBCAT000052)
- Proteins (/categories/DBCAT000020)

UNII	64FS3BFH5W (http://fdasis.nlm.nih.gov/srs/srsdirect.jsp?regno=64FS3BFH5W)
CAS number	11096-26-7

Pharmacology

Indication	For use in the treatment of symptomatic anaemia associated with chronic renal failure (CRF) in adult and paediatric patients. Also for use in the treatment of anaemia and reduction of transfusion requirements in adult patients receiving chemotherapy for solid tumours, malignant lymphoma or multiple myeloma, and at risk of transfusion as assessed by the patient's general status (e.g. cardiovascular status, pre-existing anaemia at the start of chemotherapy). Also for used to increase the yield of autologous blood from patients in a predonation program. When administered subcutaneously, Epoetin Zeta is equivalent to Epoetin Alfa in terms of clinical effectiveness.
Structured Indications	• Anemias (/indications/DBCOND0031070)
Pharmacodynamics	Used in the treatment of anemia. Involved in the regulation of erythrocyte differentiation and the maintenance of a physiological level of circulating erythrocyte mass.
Mechanism of action	Binding of erythropoietin to the erythropoietin receptor leads to receptor dimerization, which facilitates activation of JAK-STAT signaling pathways within the cytosol. Activated STAT (signal transducers and activators of transcription) proteins are then translocated to the nucleus where they serve as transcription factors which regulate the activation of specific genes involved in cell division or differentiation.

Target	Kind	Pharmacological action	Actions	Organism	UniProt ID	
Erythropoietin receptor	Protein	yes	agonist	Human	P19235 (http://www.uniprot.org/uniprot/P19235)	details

Related Articles	
Absorption	Not Available
Volume of distribution	Not Available
Protein binding	Not Available
Metabolism	Not Available

Route of elimination	Not Available
Half life	Toxicokinetic results from rats in a 13 week toxicity study after a single subcutaneous dose: • 7.37 hours (+/- 0.70) with 500 IU/kg [test 1] • 8.63 hours (+/- 2.78) with 2500 IU/kg [test 2] • 8.76 hours (+/- 1.46) with 2500 IU/kg [reference dose]
Clearance	• 20.2 +/- 15.9 mL/h/kg [150 Units/kg SC TIW, Week 1 when anemic cancer patients were receiving chemotherapy] • 23.6 +/- 9.5 mL/h/kg [150 Units/kg SC TIW, Week 3 when anemic cancer patients were not receiving chemotherapy] • 9.2 +/- 4.7 mL/h/kg [40,000 Units/kg SC TIW, Week 1 when anemic cancer patients were receiving chemotherapy] • 13.9 +/- 7.6 mL/h/kg [40,000 Units/kg SC TIW, Week 3 when anemic cancer patients were not receiving chemotherapy]
Toxicity	Not Available
Affected organisms	• Humans and other mammals
Pathways	Not Available
Pharmacogenomic Effects/ADRs	Not Available

Interactions

Drug Interactions

Show 10 entries Search

Drug	Interaction	Drug group
Lenalidomide (/drugs/DB00480)	Erythropoietin may increase the thrombogenic activities of Lenalidomide.	Approved
Nandrolone decanoate (/drugs/DB08804)	Nandrolone decanoate may increase the stimulatory activities of Erythropoietin.	Approved, Illicit
Nandrolone phenpropionate (/drugs/DB00984)	Nandrolone phenpropionate may increase the stimulatory activities of Erythropoietin.	Approved, Illicit
Thalidomide (/drugs/DB01041)	Erythropoietin may increase the thrombogenic activities of Thalidomide.	Approved, Investigational, Withdrawn

Showing 1 to 4 of 4 entries Previous 1 Next

Food Interactions	Not Available

References

Synthesis Reference	Not Available
General References	1. Wizemann V, Rutkowski B, Baldamus C, Scigalla P, Koytchev R: Comparison of the therapeutic effects of epoetin zeta to epoetin alfa in the maintenance phase of renal anaemia treatment. Curr Med Res Opin. 2008 Mar;24(3):625-37. doi: 10.1185/030079908X273264. [PubMed:18208642 (http://www.ncbi.nlm.nih.gov/pubmed/18208642)] 2. Krivoshiev S, Wizemann V, Czekalski S, Schiller A, Pljesa S, Wolf-Pflugmann M, Siebert-Weigel M, Koytchev R, Bronn A: Therapeutic equivalence of epoetin zeta and alfa, administered subcutaneously, for maintenance treatment of renal anemia. Adv Ther. 2010 Feb;27(2):105-17. doi: 10.1007/s12325-010-0012-y. Epub 2010 Mar 30. [PubMed:20369312 (http://www.ncbi.nlm.nih.gov/pubmed/20369312)] 3. Brinks V, Hawe A, Basmeleh AH, Joachin-Rodriguez L, Haselberg R, Somsen GW, Jiskoot W, Schellekens H: Quality of original and biosimilar epoetin products. Pharm Res. 2011 Feb;28(2):386-93. doi: 10.1007/s11095-010-0288-2. Epub 2010 Oct 1. [PubMed:20886265 (http://www.ncbi.nlm.nih.gov/pubmed/20886265)] 4. Link [Link (http://www.ema.europa.eu/docs/en_GB/document_library/EPAR_-_Scientific_Discussion/human/000872/WC500054374.pdf)]
External Links	**Resource** / **Link** UniProt — P01588 (http://www.uniprot.org/uniprot/P01588) Genbank — X02158 (http://www.ncbi.nlm.nih.gov/entrez/viewer.fcgi?val=X02158) PharmGKB — PA10072 (http://www.pharmgkb.org/drug/PA10072) Drug Product Database — 299 (http://webprod5.hc-sc.gc.ca/dpd-bdpp/info.do?code=299&lang=eng) RxList — http://www.rxlist.com/cgi/generic/epoetin.htm (http://www.rxlist.com/cgi/generic/epoetin.htm) Drugs.com — http://www.drugs.com/cdi/epoetin-alfa.html (http://www.drugs.com/cdi/epoetin-alfa.html) Wikipedia — Epoetin_alfa (http://en.wikipedia.org/wiki/Epoetin_alfa)
ATC Codes	B03XA01 — Erythropoietin (/atc/B03XA01) B03XA — Other antianemic preparations (/atc/B03XA) B03X — OTHER ANTIANEMIC PREPARATIONS (/atc/B03X) B03 — ANTIANEMIC PREPARATIONS (/atc/B03) B — BLOOD AND BLOOD FORMING ORGANS (/atc/B)
AHFS Codes	• 20:16.00
PDB Entries	• 1EER (http://www.rcsb.org/pdb/explore.do?structureId=1EER)
FDA label	Download (//s3-us-west-2.amazonaws.com/drugbank/fda_labels/DB00016.pdf?1265922800) (2.73 MB)
MSDS	Not Available
Clinical Trials	
Clinical Trials	Show 10 entries Search **Phase** / **Status** / **Purpose** / **Conditions** / **Count**

1	Active Not Recruiting	Basic Science	There Are no Conditions Under Study. Healthy Volunteers (/indications/DBCOND0084136)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0084136&phase=1&purpose=basic_science&status=active_not_recruiting)
1	Completed	Not Available	Anemias (/indications/DBCOND0031070) / Chronic Kidney Failure (/indications/DBCOND0029486)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0031070%2CDBCOND0029486&phase=1&status=completed)
1	Completed	Basic Science	Renal Effects (/indications/DBCOND0056920)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0056920&phase=1&purpose=basic_science&status=completed)
1	Completed	Prevention	Parkinson's Disease (PD) (/indications/DBCOND0053495)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0053495&phase=1&purpose=prevention&status=completed)
1	Completed	Treatment	Anemias (/indications/DBCOND0031070) / Chronic Kidney Disease (CKD) (/indications/DBCOND0048800)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0031070%2CDBCOND0048800&phase=1&purpose=treatment&status=completed)
1	Completed	Treatment	Cerebral Palsy (CP) (/indications/DBCOND0044923)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0044923&phase=1&purpose=treatment&status=completed)
1	Completed	Treatment	Chronic Kidney Disease (CKD) (/indications/DBCOND0048800) / Pulmonary Hypertension (PH) (/indications/DBCOND0051788) / Sickle Cell Disorders (/indications/DBCOND0051876)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0048800%2CDBCOND0051788%2CDBCOND0051876&phase=1&purpose=treatment&status=completed)
1	Completed	Treatment	Chronic Renal Failure (CRF) (/indications/DBCOND0051172)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0051172&phase=1&purpose=treatment&status=completed)
1	Completed	Treatment	Human Immunodeficiency Virus (HIV) Infections (/indications/DBCOND0035016)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0035016&phase=1&purpose=treatment&status=completed)
1	Completed	Treatment	Hypoxic-Ischaemic Encephalopathy (/indications/DBCOND0080116)	1 (/drugs/DB00016/clinical_trials?conditions=DBCOND0080116&phase=1&purpose=treatment&status=completed)

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Pharmacoeconomics

Manufacturers	Not Available
Packagers	• Amgen Inc. (http://www.amgen.com) • Centocor Ortho Biotech Inc. (http://www.centocororthobiotech.com) • DSM Corp. (http://www.dsm.com) • Janssen-Ortho Inc. (http://www.janssen-ortho.com) • JHP Pharmaceuticals LLC (http://www.jhppharma.com) • Ortho-McNeil-Janssen Pharmaceuticals Inc. (http://www.ortho-mcneil.com) • Physicians Total Care Inc. (http://www.physicianstotalcare.com)

Dosage forms

Show 10 entries Search

Form	Route	Strength
Injection, solution	Intravenous; Subcutaneous	1000 IU/0.5ml
Injection, solution	Intravenous; Subcutaneous	10000 IU/1.0ml
Injection, solution	Intravenous; Subcutaneous	2000 IU/1.0ml
Injection, solution	Intravenous; Subcutaneous	20000 IU/0.5ml
Injection, solution	Intravenous; Subcutaneous	3000 IU/0.3ml
Injection, solution	Intravenous; Subcutaneous	30000 IU/0.75ml
Injection, solution	Intravenous; Subcutaneous	4000 IU/0.4ml
Injection, solution	Intravenous; Subcutaneous	40000 IU/1.0ml
Injection, solution	Intravenous; Subcutaneous	40000 IU/1ml
Injection, solution	Intravenous; Subcutaneous	5000 IU/0.5ml

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Prices

Show 10 entries

Unit description	Cost	Unit
Epogen 40000 unit/ml Solution 1 Box Contains Ten 1ml Vials	6852.3USD	box
Epogen 20000 unit/ml Solution 1 Box Contains Ten 1ml Vials	3157.44USD	box
Epogen 10000 unit/ml Solution 1 Box Contains Ten 1ml Vials	1578.72USD	box
Procrit 40000 unit/ml vial	767.03USD	vial
Procrit 10000 unit/ml vial	710.87USD	vial
Epogen 40000 unit/ml vial	640.37USD	ml
Procrit 20000 unit/ml vial	388.97USD	ml
Procrit 20000 unit/ml Solution	378.14USD	ml
Procrit 10000 unit/ml Solution 2ml Vial	358.02USD	vial
Epogen 10000 unit/ml Solution 2ml Vial	315.74USD	vial

Showing 1 to 10 of 18 entries Previous 1 2 Next

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Patents

Show 10 entries Search

Patent Number	Pediatric Extension	Approved	Expires (estimated)	
CA1339047 (https://patents.google.com/patent/CA1339047)	No	1997-05-27	2014-05-27	

Showing 1 to 1 of 1 entries Previous 1 Next

Properties

State Liquid

Experimental Properties

Property	Value	Source
melting point (°C)	53 °C	Arakawa, T. et al., Biosci. Biotechnol. Biochem. 65:1321-1327 (2001)
isoelectric point	8.75	Not Available

Taxonomy	
Description	Not Available
Kingdom	Organic Compounds
Super Class	Organic Acids
Class	Carboxylic Acids and Derivatives
Sub Class	Amino Acids, Peptides, and Analogues
Direct Parent	Peptides
Alternative Parents	Not Available
Substituents	Not Available
Molecular Framework	Not Available
External Descriptors	Not Available

Targets

1. Erythropoietin receptor (/biodb/polypeptides/P19235)

Details (/biodb/polypeptides/P19235)

Kind Protein
Organism Human
Pharmacological action yes
Actions agonist

General Function: Identical protein binding
Specific Function: Receptor for erythropoietin. Mediates erythropoietin-induced erythroblast proliferation and differentiation. Upon EPO stimulation, EPOR dimerizes triggering the JAK2/STAT5 signaling cascade. In some cell types, can also activate STAT1 and STAT3. May also activate the LYN tyrosine kinase.Isoform EPOR-T acts as a dominant-negative receptor of EPOR-mediated signaling.
Gene Name: EPOR
Uniprot ID: P19235 (http://www.uniprot.org/uniprot/P19235)
Uniprot Name: Erythropoietin receptor
Molecular Weight: 55064.725 Da

References

1. LaMontagne KR, Butler J, Marshall DJ, Tullai J, Gechtman Z, Hall C, Meshaw A, Farrell FX: Recombinant epoetins do not stimulate tumor growth in erythropoietin receptor-positive breast carcinoma models. Mol Cancer Ther. 2006 Feb;5(2):347-55. [PubMed:16505108 (http://www.ncbi.nlm.nih.gov/pubmed/16505108)]
2. Kokhaei P, Abdalla AO, Hansson L, Mikaelsson E, Kubbies M, Haselbeck A, Jernberg-Wiklund H, Mellstedt H, Osterborg A: Expression of erythropoietin receptor and in vitro functional effects of epoetins in B-cell malignancies. Clin Cancer Res. 2007 Jun 15;13(12):3536-44. [PubMed:17575216 (http://www.ncbi.nlm.nih.gov/pubmed/17575216)]
3. Chen X, Ji ZL, Chen YZ: TTD: Therapeutic Target Database. Nucleic Acids Res. 2002 Jan 1;30(1):412-5. [PubMed:11752352 (http://www.ncbi.nlm.nih.gov/pubmed/11752352)]

Drug created on June 13, 2005 07:24 / Updated on June 22, 2017 09:26

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(http://www.aihealthsolutions.ca)

(http://genome