

Blue Cross Blue Shield of Massachusetts is an Independent Licenses of the Blue Cross and Blue Shield Association

# Pharmacy Medical Policy Growth Hormone and Insulin-like Growth Factor

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- Policy Number: 257

BCBSA Reference Number: 5.01.06

### **Related Policies**

• N/A

#### **Prior Authorization Information**

Policy	<ul> <li>Prior Authorization</li> <li>Step Therapy</li> <li>Quantity Limit</li> </ul>	Reviewing Department	Pharmacy Operations: Tel: 1-800-366-7778 Fax: 1-800-583-6289
		Policy Effective Date	12/2023
Pharmacy (Rx) or Medical (MED) benefit coverage     ⊠ Rx       □ MED		To request for coverage: Providers may call, fax, or mail the attached form (Formulary Exception/Prior Authorization form) to the address below. Blue Cross Blue Shield of Massachusetts Pharmacy Operations Department 25 Technology Place Hingham, MA 02043 Tel: 1-800-366-7778 Fax: 1-800-583-6289 Individual Consideration for the atypical patient: Policy for requests that do not meet clinical criteria of this policy, see section labeled Individual Consideration	
<ul> <li>Policy applies to Commercial Members:         <ul> <li>Managed Care (HMO and POS),</li> <li>PPO and Indemnity</li> <li>MEDEX with Rx plan</li> <li>Managed Major Medical with Custom BCBSMA Formulary</li> <li>Comprehensive Managed Major Medical with Custom BCBSMA Formulary</li> <li>Managed Blue for Seniors with Custom BCBSMA Formulary</li> </ul> </li> <li>Policy does NOT apply to:</li> </ul>			

## **Summary**

This is a comprehensive policy covering prior authorization requirements for Growth Hormones and Insulin-like Growth Factors.

Formulary status/requirements of the medications affected by this policy

Drug	Formulary Status (BCBSMA Commercial Plan)	Requirement	Additional Considerations	
Formulary, Preferred				
Egrifta <sup>™</sup> (tesamorelin)				
Humatrope <sup>®</sup> (somatropin)				
Increlex <sup>®</sup> (mecasermin)		PA Required. See		
Nutropin <sup>®</sup> Depot (somatropin)		below for criteria.		
Nutropin <sup>®</sup> (somatropin)	Covered, PA	Supporting Documentation Required		
Nutropin AQ <sup>®</sup> (somatropin)	n			
Serostim <sup>®</sup> (somatropin)	n de la constante de			
Serostim <sup>®</sup> LQ (somatropin)				
Zorbtive <sup>®</sup> (somatropin)				
Formulary, Non-Preferred			*SPBO - Pharmacv	
Ngenla <sup>®</sup> (Somatrogon)		Meet PA Criteria AND Trial and failure of	benefit coverage only	
Sogroya <sup>®</sup> (somapacitan)	Covered, PA			
Skytrofa <sup>™</sup> (lonapegsomatropin-tcgd)		ONE drug in step 1		
Non-Formulary, Non-Preferred				
Genotropin <sup>®</sup> (somatropin)				
Genotropin Miniquick <sup>®</sup> (somatropin)				
Norditropin <sup>®</sup> (somatropin)	<u>vin</u> <sup>®</sup> (somatropin) Meet PA cri			
Omnitrope <sup>®</sup> (somatropin)	NFNC, PA	covered formulary alternatives		
Saizen <sup>®</sup> (somatropin)				
Saizenprep <sup>®</sup> (somatropin)				
<b><u>Zomación</u></b> ~ (somatropin)				

PA – Prior Authorization; NFNC – Non-formulary, Non-Covered; SPBO – Specialty Pharmacy access

### Policy

Length of Approval	12 months, unless otherwise specified	
Formulary Status	All requests must meet the Prior Authorizations requirement. For non-covered medications, the member <u>must</u> also have had a previous treatment failure with, or contraindication to, <u>at least two</u> covered formulary alternatives when available. See section on <u>individual consideration</u> for more information if you require an exception to any of these criteria requirements for an atypical patient.	
Member cost share consideration	A higher non-preferred cost share may be applied if an exception request is approved for coverage of a non-preferred or a non-formulary/non-covered drug.	

#### **Growth Hormones**

# **Zorbtive**

**Zorbtive** may be considered <u>MEDICALLY NECESSARY</u> and covered for 4 weeks of treatment when <u>ALL</u> of the below criteria are met:

- 1. Documented diagnosis of Short Bowel Syndrome; AND
- 2. Age ≥ 18 years; **AND**
- 3. Currently receiving specialized nutritional support such as dietary adjustments, enteral feedings, parenteral nutrition, or micronutrient supplementation.

# Egrifta <sup>™</sup>

**Egrifta** may be covered and considered **<u>MEDICALLY NECESSARY</u>** and covered when <u>ALL</u> of the below criteria are met:

- 1. Documented HIV infection; AND
- 2. Used for the reduction of excess abdominal fat due to lipodystrophy due to antiretroviral therapy

## Serostim <sup>™</sup>

**Serostim** may be covered and considered <u>MEDICALLY NECESSARY</u> and covered when <u>ALL</u> of the below criteria are met:

- 1. Documented HIV infection; AND
- 2. Wasting or cachexia to increase lean body mass and body weight, and improve physical endurance

## Humatrope<sup>®</sup>, Nutropin<sup>®</sup> or Nutropin AQ<sup>®</sup>, Nutropin Depot<sup>®</sup>

## Initial Criteria

Humatrope, Nutropin and Nutropin AQ may be covered and considered <u>MEDICALLY NECESSARY</u> for Any of the following indications:

- 1. Children with proven growth hormone deficiency (GHD)
- 2. Children with growth failure due to Prader-Willi syndrome, who do not have the following contraindications: history of upper airway obstruction or sleep apnea or severe respiratory impairment
- 3. Children with height below the 3rd percentile for chronologic age with chronic renal insufficiency
- 4. Patients with Turner syndrome
- 5. Patients with short stature due to Noonan syndrome
- 6. Children with short stature due to SHOX (short stature homeobox-containing gene) deficiency
- 7. Promotion of wound healing in patients with 3<sup>rd</sup>-degree burns
- 8. Prevention of growth delay in children with severe burns
- 9. Patients with HIV/AIDS wasting syndrome who meet all the following:
- a. Weight loss of at least 10% from baseline weight or BMI<20 kg/m<sup>2</sup>
- b. Wasting syndrome rather than malnutrition, mental illness, endocrine disease, or other causes for weight loss
- c. Concomitant anti-viral therapy for the duration of treatment
- 10. Patients with short bowel syndrome receiving specialized nutritional support in conjunction with optimal management of short bowel syndrome
- 11. Adults with proven growth hormone deficiency (GHD)\*

#### \*Proven adult GHD Defined as:

- An abnormal response to TWO provocative stimulation tests, such as L-dopa, clonidine, glucagon, arginine, growth hormone–releasing hormone (GH-RH), or insulin; **OR**
- An abnormal response to ONE provocative stimulation test in patients with defined central nervous system pathology, history of irradiation, multiple pituitary hormone deficiency, or a genetic defect; OR
- Low IGF-I concentration in patients with complete hypopituitarism

### Continuation Criteria For Pediatric Patients (Age < 18 Years)

Humatrope, Nutropin or Nutropin AQ may be covered for continuation when ALL of the below criteria are met:

- 1. Open epiphyses (as determined within the last year by radiographic evidence); AND
- 2. No evidence of tumor activity or active neoplasm; AND
- 3. Growth velocity > 2cm/yr; AND
- 4. Absence of significant side effects; AND
- 5. Compliance with therapy; AND
- 6. NOT used in combination with another somatropin agent (such as Serostim, Zorbtive or any other GH).
- 7. For Nutropin Depot: Trial and failure or treatment-limiting adverse effects of formulary endogenous growth hormone (GH) products Humatrope or Nutropin or Nutropin AQ

# <u>Genotropin <sup>®</sup>, Genotropin Miniquick <sup>®</sup>, Norditropin <sup>®</sup>, Omnitrope <sup>®</sup>, Saizen <sup>®</sup>,</u> Saizenprep<sup>®</sup>, and Zomacton <sup>®</sup>

**Genotropin, Genotropin Miniquick, Norditropin, Omnitrope, Saizen, Saizenprep,** and **Zomacton** may be covered and considered <u>MEDICALLY NECESSARY</u> only after treatment failure with, or contraindication to at least TWO formulary alternatives (see drug chart). Please see criteria for <u>Humatrope, Nutropin and Nutropin AQ</u> above for all covered indications.

## **Long-Acting Growth Hormones**

### Ngenla<sup>®</sup>, Skytrofa<sup>™</sup> and Sogroya<sup>®</sup>

**Ngenla, Skytrofa** or **Sogroya** may be considered <u>MEDICALLY NECESSARY</u> and covered when ALL of the following criteria met:

- 1. Age is greater than or equal to 1 years of age; AND
- 2. The child's weight is at least 11.5 kg (are25.3 Lbs.); AND
- 3. Confirmed open epiphyses; AND
- 4. Confirmed diagnosis with proven growth failure due to inadequate secretion of endogenous growth hormone (GH); **AND**
- 5. Trial and failure or treatment-limiting adverse effects of formulary endogenous growth hormone (GH) products **Humatrope or Nutropin or Nutropin AQ**

### **Insulin-Like Growth Factors**

## Increlex<sup>®</sup>

**Increlex** may be considered **MEDICALLY NECESSARY** and covered when ALL of the following criteria are met:

- Documented diagnosis of growth failure in children with severe primary insulin-like growth factor-1 (IGF-1) deficiency (primary IGFD) OR with growth hormone (GH) gene deletion who have developed neutralizing antibodies to GH; AND
- 2. Height standard deviation score less than or equal to -3 for age and sex; AND
- 3. Basal IGF-1 standard deviation score less than or equal to -3 for age and sex; AND
- 4. Normal or elevated growth hormone (defined as stimulated serum GH peak level of greater than 10 ng/ml or basal (unstimulated) serum GH level greater than 5ng/ml).

BCBSMA does NOT cover **Insulin-like Growth Factor** for secondary forms of IGF-1 deficiency including (but not limited to):<sup>23</sup>

- 1. GH Deficiency
- 2. Malnutrition
- 3. Hypothyroidism

4. Chronic treatment with pharmacologic doses of anti-inflammatory steroids.

# **Non-Covered Indications for Growth Hormone**

The following indications approved by the Food and Drug Administration are considered NOT **MEDICALLY NECESSARY** and therefore not covered:

- 1. Pediatric patients born small for gestational age who fail to show catch-up growth by age 2 years
- 2. Children with height standard deviation score of -2.25 or below without documented growth hormone deficiency.

#### Other Non-Covered Indications:

- 1. Short children who are not GH deficient<sup>22</sup>
- 2. Growth hormone insensitivity (Laron Syndrome)<sup>5</sup>
- 3. Children with constitutional growth delay<sup>22</sup>
- 4. Children with growth failure caused by glucocorticoids<sup>22</sup>
- Children who are not growth hormone deficient but have short stature associated with chronic disease<sup>11</sup>
- 6. Children with functioning renal transplants
- Children with chromosomal and genetic disorders<sup>11</sup> (except Turner's and Prader Willi Syndromes)<sup>11</sup> or familial short stature<sup>11</sup>
- 8. Russell Silver syndrome<sup>21</sup>
- 9. Anabolic therapy to enhance body mass or strength for professional, recreational or social reasons<sup>22</sup>
- Anabolic therapy, except for AIDS, provided to counteract acute or chronic catabolic illness (e.g., surgery outcomes, trauma, cancer, chronic hemodialysis) producing catabolic (protein wasting) changes in both adult and pediatric patients<sup>22</sup>
- 11. Altered body habitus or lipodystrophy such as buffalo hump associated with antiviral therapy in HIVinfected patients<sup>22</sup>
- 12. In conjunction with GnRH (gonadotropin releasing hormone) analogs as a treatment of precocious puberty<sup>22</sup>
- 13. Treatment of obesity<sup>22</sup>
- 14. Treatment of cystic fibrosis<sup>22</sup>
- 15. Treatment of idiopathic dilated cardiomyopathy<sup>22</sup>
- 16. Treatment of juvenile idiopathic arthritis.<sup>22</sup>
- 17. We do not cover GH therapy for congestive heart failure (CHF), because the precise mechanism of GH action has not been established and its long-term effectiveness is not known.<sup>10</sup>
- 18. Adults with age-related GH deficiency (AR-GHD), who have no organic causes or childhood origin of growth hormone deficiency. It has not been proven in the medical literature to improve the disability and quality of life of patients with AR-GHD.<sup>17</sup>

### **Investigational Indications**

The following indications are considered **INVESTIGATIONAL** and not covered:

- 1. Treatment of altered body habitus (e.g., buffalo hump) associated with antiviral therapy in HIVinfected patients
- 2. Constitutional delay (lower than expected height percentiles compared with target height percentiles and delayed skeletal maturation when growth velocities and rates of bone age advancement are normal)
- 3. Treatment of children with "genetic potential" (ie, lower than expected height percentiles based on parents' height)
- 4. In conjunction with gonadotropin-releasing hormone analogues as a treatment of precocious puberty
- 5. Growth hormone therapy in older adults without proven deficiency

- 6. Treatment of cystic fibrosis
- 7. Anabolic therapy (except for AIDS) provided to counteract acute or chronic catabolic illness (eg, surgery outcomes, trauma, cancer, chronic hemodialysis, chronic infectious disease) producing catabolic (protein wasting) changes in both adult and pediatric patients
- 8. Anabolic therapy to enhance body mass or strength for professional, recreational, or social reasons
- 9. Glucocorticoid-induced growth failure
- 10. Short stature due to Down syndrome
- 11. Treatment of obesity
- 12. Treatment of idiopathic dilated cardiomyopathy
- 13. Treatment of juvenile idiopathic or juvenile chronic arthritis.

#### **Other Information**

Blue Cross Blue Shield of Massachusetts (BCBSMA\*) members (other than Medex®; Blue MedicareRx, Medicare Advantage plans that include prescription drug coverage) will be required to fill their prescriptions for the above medications at one of the providers in our retail specialty pharmacy network.

#### **Provider Documentation Requirements**

Documentation from the provider to support a reason preventing trial of formulary alternative(s) must include the name and strength of alternatives tried and failed (if alternatives were tried, including dates if available) and specifics regarding the treatment failure. Documentation to support clinical basis preventing switch to formulary alternative should also provide specifics around clinical reason.

#### **Individual Consideration (For Atypical Patients)**

Our medical policies are written for most people with a given condition. Each policy is based on peer reviewed clinical evidence. We also take into consideration the needs of atypical patient populations and diagnoses.

If the coverage criteria outlined is unlikely to be clinically effective for the prescribed purpose, the health care provider may request an exception to cover the requested medication based on an individual's unique clinical circumstances. This is also referred to as "individual consideration" or an "exception request."

Some reasons why you may need us to make an exception include: therapeutic contraindications; history of adverse effects; expected to be ineffective or likely to cause harm (physical, mental, or adverse reaction).

To facilitate a thorough and prompt review of an exception request, we encourage the provider to include additional supporting clinical documentation with their request. This may include:

- Clinical notes or supporting clinical statements;
- The name and strength of formulary alternatives tried and failed (if alternatives were tried) and specifics regarding the treatment failure, if applicable;
- Clinical literature from reputable peer reviewed journals;
- References from nationally recognized and approved drug compendia such as American Hospital Formulary Service<sup>®</sup> Drug Information (AHFS-DI), Lexi-Drug, Clinical Pharmacology, Micromedex or Drugdex<sup>®</sup>; and
- References from consensus documents and/or nationally sanctioned guidelines.

Providers may call, fax or mail relevant clinical information, including clinical references for individual patient consideration, to:

Blue Cross Blue Shield of Massachusetts Pharmacy Operations Department 25 Technology Place Hingham, MA 02043 Phone: 1-800-366-7778 We may also use prescription claims records to establish prior use of formulary alternatives or to show if step therapy criteria has been met. We will require the provider to share additional information when prescription claims data is either not available or the medication fill history fails to establish use of preferred formulary medications or that step therapy criteria has been met.

## **Policy History**

Date	Action
12/2023	Reformatted Policy.
9/2023	Updated to add Sogroya ${\ensuremath{\mathbb R}}$ to the policy and updated IC to align with 118E MGL §
	51A.
7/2023	Updated to add Saizenprep <sup>®</sup> to the policy and remove Tev-Tropin <sup>®</sup> and Zorbtive <sup>®</sup>
0/0000	due to market withdrawai.
2/2022	Updated policy to include Skytrota 1 <sup>th</sup> to the policy.
12/2021	references added.
12/2020	BCBSA National medical policy review. No changes to policy statements. New
10/2020	Clarified coding information
10/2020	
1/2019	Clarified coding information.
8/2018	Clarified coding information.
5/2018	Clarify criteria with Association language
10/2017	Lindated to change Walgreens Specialty Name
7/2017	Updated to add AllCare to Pharmacy Specialty list
6/2017	Undated address for Pharmacy Operations
4/2017	Clarified criteria for Omnitrope®
1/2016	New references added from BCBSA National medical policy
10/2015	Lindated to included revised language for Pharmacy only medications
7/2015	Added Zomacton <sup>®</sup> To the policy
12/2013	New references added from BCBSA National medical policy
7/2014	Lipdated to include ICD-10 and to add Coverage for Egrifta™
2/2014	Removal of Curascript from specialty pharmacy section
1/2014	Undated ExpressPAth Language and removed Blue Value
4/2012	Undated 4/2012 to undate specialty pharmacy contact information
11/2011-4/2012	Medical policy ICD 10 remediation: Formatting, editing and coding updates
11/2011 1/2012	No changes to policy statements.
1/2012	Updated to include medical necessity criteria requirement to have treatment failure
	or contraindication to formulary products.
5/2011	Reviewed - Medical Policy Group - Pediatrics and Endocrinology.
	No changes to policy statements.
5/2011	Updated to include new FDA approved medication Egrifta <sup>™</sup> .
5/2010	Reviewed - Medical Policy Group - Pediatrics and Endocrinology.
	No changes to policy statements.
2/2010	Reviewed - Medical Policy Group - Psychiatry and Ophthalmology.
	No changes to policy statements.
2/2010	Updated to reflect formulary changes and update Specialty Pharmacy information for
10/2000	Valgieens Operially Fildinary.
10/2009	policy.
5/2009	Reviewed - Medical Policy Group - Pediatrics and Endocrinology.
	No changes to policy statements

2/2009	Reviewed - Medical Policy Group - Psychiatry and Ophthalmology.
	No changes to policy statements.
5/2008	Reviewed - Medical Policy Group - Pediatrics and Endocrinology.
	No changes to policy statements.
2/2008	Reviewed - Medical Policy Group - Psychiatry and Ophthalmology.
	No changes to policy statements.
5/2007	Reviewed - Medical Policy Group - Pediatrics and Endocrinology.
	No changes to policy statements.
2/2007	Reviewed - Medical Policy Group - Psychiatry and Ophthalmology.
	No changes to policy statements.
10/1989	New policy, effective 10/1989, describing covered and non-covered indications.
Forms	

To request prior authorization using the Massachusetts Standard Form for Medication Prior Authorization Requests (eForm), click the link below:

https://www.bluecrossma.org/medical-policies/sites/g/files/csphws2091/files/acquiadamassets/023%20E%20Form%20medication%20prior%20auth%20instruction%20prn.pdf

#### OR

#### Print and fax, Massachusetts Standard Form for Medication Prior Authorization Requests #434

#### References

- 1. Lo JC, Mulligan K, Tai VW, et al. "Buffalo hump" in men with HIV-1 infection. Lancet. Mar 21 1998; 351(9106): 867-70. PMID 9525364
- Strasburger CJ, Vanuga P, Payer J, et al. MOD-4023, a long-acting carboxy-terminal peptidemodified human growth hormone: results of a Phase 2 study in growth hormone-deficient adults. Eur J Endocrinol. Mar 2017; 176(3): 283-294. PMID 27932411
- Luo X, Hou L, Liang L, et al. Long-acting PEGylated recombinant human growth hormone (Jintrolong) for children with growth hormone deficiency: phase II and phase III multicenter, randomized studies. Eur J Endocrinol. Aug 2017; 177(2): 195-205. PMID 28566441
- 4. Hoybye C, Pfeiffer AF, Ferone D, et al. A phase 2 trial of long-acting TransCon growth hormone in adult GH deficiency. Endocr Connect. Apr 2017; 6(3): 129-138. PMID 28196799
- Blethen SL, Allen DB, Graves D, et al. Safety of recombinant deoxyribonucleic acid-derived growth hormone: The National Cooperative Growth Study experience. J Clin Endocrinol Metab. May 1996; 81(5): 1704-10. PMID 8626820
- Critical evaluation of the safety of recombinant human growth hormone administration: statement from the Growth Hormone Research Society. J Clin Endocrinol Metab. May 2001; 86(5): 1868-70. PMID 11344173
- 7. Hoybye C, Beck-Peccoz P, Murray RD, et al. Safety and effectiveness of replacement with biosimilar growth hormone in adults with growth hormone deficiency: results from an international, post-marketing surveillance study (PATRO Adults). Pituitary. Aug 2021; 24(4): 622-629. PMID 33742320
- 8. Beck-Peccoz P, Hoybye C, Murray RD, et al. Malignancy risk in adults with growth hormone deficiency undergoing long-term treatment with biosimilar somatropin (Omnitrope (R)): data from the PATRO Adults study. Ther Adv Endocrinol Metab. 2020; 11: 2042018820943377. PMID 32973992
- Thomas-Teinturier C, Oliver-Petit I, Pacquement H, et al. Influence of growth hormone therapy on the occurrence of a second neoplasm in survivors of childhood cancer. Eur J Endocrinol. Oct 2020; 183(4): 471-480. PMID 32738133
- Swerdlow AJ, Cooke R, Beckers D, et al. Cancer Risks in Patients Treated With Growth Hormone in Childhood: The SAGhE European Cohort Study. J Clin Endocrinol Metab. May 01 2017; 102(5): 1661-1672. PMID 28187225
- Carel JC, Ecosse E, Landier F, et al. Long-term mortality after recombinant growth hormone treatment for isolated growth hormone deficiency or childhood short stature: preliminary report of the French SAGhE study. J Clin Endocrinol Metab. Feb 2012; 97(2): 416-25. PMID 22238382
- 12. Poidvin A, Touze E, Ecosse E, et al. Growth hormone treatment for childhood short stature and risk of stroke in early adulthood. Neurology. Aug 26 2014; 83(9): 780-6. PMID 25122206
- 13. Tidblad A, Bottai M, Kieler H, et al. Association of Childhood Growth Hormone Treatment With Longterm Cardiovascular Morbidity. JAMA Pediatr. Feb 01 2021; 175(2): e205199. PMID 33346824

- 14. Pfizer. Highlights of Prescribing Information: Genotropin (somatropin [rDNA origin] for injection). 2019; http://labeling.pfizer.com/ShowLabeling.aspx?id=577. Accessed August 15, 2021.
- 15. Eli Lilly. Highlights of Prescribing Information: Humatrope (somatropin [rDNA ORIGIN] for injection, for Subcutaneous Use). 2019; http://pi.lilly.com/us/humatrope-pi.pdf. Accessed August 15, 2021.
- Root AW, Kemp SF, Rundle AC, et al. Effect of long-term recombinant growth hormone therapy in children--the National Cooperative Growth Study, USA, 1985-1994. J Pediatr Endocrinol Metab. 1998; 11(3): 403-12. PMID 11517956
- 17. Reiter EO, Price DA, Wilton P, et al. Effect of growth hormone (GH) treatment on the near-final height of 1258 patients with idiopathic GH deficiency: analysis of a large international database. J Clin Endocrinol Metab. Jun 2006; 91(6): 2047-54. PMID 16537676
- Beauregard C, Utz AL, Schaub AE, et al. Growth hormone decreases visceral fat and improves cardiovascular risk markers in women with hypopituitarism: a randomized, placebo-controlled study. J Clin Endocrinol Metab. Jun 2008; 93(6): 2063-71. PMID 18381581
- Widdowson WM, Gibney J. The effect of growth hormone replacement on exercise capacity in patients with GH deficiency: a metaanalysis. J Clin Endocrinol Metab. Nov 2008; 93(11): 4413-7. PMID 18697875
- Widdowson WM, Gibney J. The effect of growth hormone (GH) replacement on muscle strength in patients with GH-deficiency: a meta-analysis. Clin Endocrinol (Oxf). Jun 2010; 72(6): 787-92. PMID 19769614
- Xue P, Wang Y, Yang J, et al. Effects of growth hormone replacement therapy on bone mineral density in growth hormone deficient adults: a meta-analysis. Int J Endocrinol. 2013; 2013: 216107. PMID 23690770
- 22. Barake M, Klibanski A, Tritos NA. Effects of recombinant human growth hormone therapy on bone mineral density in adults with growth hormone deficiency: a meta-analysis. J Clin Endocrinol Metab. Mar 2014; 99(3): 852-60. PMID 24423364
- 23. Hoffman AR, Kuntze JE, Baptista J, et al. Growth hormone (GH) replacement therapy in adult-onset gh deficiency: effects on body composition in men and women in a double-blind, randomized, placebo-controlled trial. J Clin Endocrinol Metab. May 2004; 89(5): 2048-56. PMID 15126520
- 24. Maison P, Chanson P. Cardiac effects of growth hormone in adults with growth hormone deficiency: a meta-analysis. Circulation. Nov 25 2003; 108(21): 2648-52. PMID 14623813
- 25. Sesmilo G, Biller BM, Llevadot J, et al. Effects of growth hormone administration on inflammatory and other cardiovascular risk markers in men with growth hormone deficiency. A randomized, controlled clinical trial. Ann Intern Med. Jul 18 2000; 133(2): 111-22. PMID 10896637
- 26. Gotherstrom G, Svensson J, Koranyi J, et al. A prospective study of 5 years of GH replacement therapy in GH-deficient adults: sustained effects on body composition, bone mass, and metabolic indices. J Clin Endocrinol Metab. Oct 2001; 86(10): 4657-65. PMID 11600522
- 27. Ishii H, Shimatsu A, Nishinaga H, et al. Assessment of quality of life on 4-year growth hormone therapy in Japanese patients with adult growth hormone deficiency: A post-marketing, multicenter, observational study. Growth Horm IGF Res. Oct 2017; 36: 36-43. PMID 28923784
- Frixou M, Vlek D, Lucas-Herald AK, et al. The use of growth hormone therapy in adults with Prader-Willi syndrome: A systematic review. Clin Endocrinol (Oxf). Apr 2021; 94(4): 645-655. PMID 33296095
- 29. Luo Y, Zheng Z, Yang Y, et al. Effects of growth hormone on cognitive, motor, and behavioral development in Prader-Willi syndrome children: a meta-analysis of randomized controlled trials. Endocrine. Feb 2021; 71(2): 321-330. PMID 33222122
- Passone CGB, Franco RR, Ito SS, et al. Growth hormone treatment in Prader-Willi syndrome patients: systematic review and meta-analysis. BMJ Paediatr Open. 2020; 4(1): e000630. PMID 32411831
- Kuppens RJ, Bakker NE, Siemensma EP, et al. Beneficial Effects of GH in Young Adults With Prader-Willi Syndrome: A 2-Year Crossover Trial. J Clin Endocrinol Metab. Nov 2016; 101(11): 4110-4116. PMID 27552545
- Craig ME, Cowell CT, Larsson P, et al. Growth hormone treatment and adverse events in Prader-Willi syndrome: data from KIGS (the Pfizer International Growth Database). Clin Endocrinol (Oxf). Aug 2006; 65(2): 178-85. PMID 16886957
- 33. Van Vliet G, Deal CL, Crock PA, et al. Sudden death in growth hormone-treated children with Prader-Willi syndrome. J Pediatr. Jan 2004; 144(1): 129-31. PMID 14722532
- 34. Grugni G, Livieri C, Corrias A, et al. Death during GH therapy in children with Prader-Willi syndrome: description of two new cases. J Endocrinol Invest. Jun 2005; 28(6): 554-7. PMID 16117198

- Wu Y, Cheng W, Yang XD, et al. Growth hormone improves growth in pediatric renal transplant recipients--a systemic review and meta-analysis of randomized controlled trials. Pediatr Nephrol. Jan 2013; 28(1): 129-33. PMID 22660958
- 36. Hodson EM, Willis NS, Craig JC. Growth hormone for children with chronic kidney disease. Cochrane Database Syst Rev. Feb 15 2012; (2): CD003264. PMID 22336787
- Hokken-Koelega AC, Stijnen T, de Muinck Keizer-Schrama SM, et al. Placebo-controlled, doubleblind, cross-over trial of growth hormone treatment in prepubertal children with chronic renal failure. Lancet. Sep 07 1991; 338(8767): 585-90. PMID 1715501
- Hokken-Koelega A, Mulder P, De Jong R, et al. Long-term effects of growth hormone treatment on growth and puberty in patients with chronic renal insufficiency. Pediatr Nephrol. Jul 2000; 14(7): 701-6. PMID 10912546
- 39. Li P, Cheng F, Xiu L. Height outcome of the recombinant human growth hormone treatment in Turner syndrome: a meta-analysis. Endocr Connect. Apr 2018; 7(4): 573-583. PMID 29581156
- 40. Baxter L, Bryant J, Cave CB, et al. Recombinant growth hormone for children and adolescents with Turner syndrome. Cochrane Database Syst Rev. Jan 24 2007; (1): CD003887. PMID 17253498
- 41. Juloski J, Dumancic J, Scepan I, et al. Growth hormone positive effects on craniofacial complex in Turner syndrome. Arch Oral Biol. Nov 2016; 71: 10-15. PMID 27372203
- 42. Giacomozzi C, Deodati A, Shaikh MG, et al. The impact of growth hormone therapy on adult height in noonan syndrome: a systematic review. Horm Res Paediatr. 2015; 83(3): 167-76. PMID 25721697
- MacFarlane CE, Brown DC, Johnston LB, et al. Growth hormone therapy and growth in children with Noonan's syndrome: results of 3 years' follow-up. J Clin Endocrinol Metab. May 2001; 86(5): 1953-6. PMID 11344190
- 44. Takeda A, Cooper K, Bird A, et al. Recombinant human growth hormone for the treatment of growth disorders in children: a systematic review and economic evaluation. Health Technol Assess. Sep 2010; 14(42): 1-209, iii-iv. PMID 20849734
- 45. Blum WF, Crowe BJ, Quigley CA, et al. Growth hormone is effective in treatment of short stature associated with short stature homeobox-containing gene deficiency: Two-year results of a randomized, controlled, multicenter trial. J Clin Endocrinol Metab. Jan 2007; 92(1): 219-28. PMID 17047016
- 46. Benabbad I, Rosilio M, Child CJ, et al. Safety Outcomes and Near-Adult Height Gain of Growth Hormone-Treated Children with SHOX Deficiency: Data from an Observational Study and a Clinical Trial. Horm Res Paediatr. 2017; 87(1): 42-50. PMID 28002818
- Child CJ, Zimmermann AG, Chrousos GP, et al. Safety Outcomes During Pediatric GH Therapy: Final Results From the Prospective GeNeSIS Observational Program. J Clin Endocrinol Metab. Feb 01 2019; 104(2): 379-389. PMID 30219920
- 48. Breederveld RS, Tuinebreijer WE. Recombinant human growth hormone for treating burns and donor sites. Cochrane Database Syst Rev. Dec 12 2012; 12: CD008990. PMID 23235668
- 49. Knox J, Demling R, Wilmore D, et al. Increased survival after major thermal injury: the effect of growth hormone therapy in adults. J Trauma. Sep 1995; 39(3): 526-30; discussion 530-2. PMID 7473919
- 50. Singh KP, Prasad R, Chari PS, et al. Effect of growth hormone therapy in burn patients on conservative treatment. Burns. Dec 1998; 24(8): 733-8. PMID 9915674
- 51. Losada F, Garcia-Luna PP, Gomez-Cia T, et al. Effects of human recombinant growth hormone on donor-site healing in burned adults. World J Surg. Jan 2002; 26(1): 2-8. PMID 11898025
- 52. Hart DW, Herndon DN, Klein G, et al. Attenuation of posttraumatic muscle catabolism and osteopenia by long-term growth hormone therapy. Ann Surg. Jun 2001; 233(6): 827-34. PMID 11371741
- 53. Aili Low JF, Barrow RE, Mittendorfer B, et al. The effect of short-term growth hormone treatment on growth and energy expenditure in burned children. Burns. Aug 2001; 27(5): 447-52. PMID 11451596
- Moyle GJ, Schoelles K, Fahrbach K, et al. Efficacy of selected treatments of HIV wasting: a systematic review and meta-analysis. J Acquir Immune Defic Syndr. Dec 01 2004; 37 Suppl 5: S262-76. PMID 15722869
- Evans WJ, Kotler DP, Staszewski S, et al. Effect of recombinant human growth hormone on exercise capacity in patients with HIV-associated wasting on HAART. AIDS Read. Jun 2005; 15(6): 301-3, 306-8, 310, 314. PMID 15962453
- 56. Wales PW, Nasr A, de Silva N, et al. Human growth hormone and glutamine for patients with short bowel syndrome. Cochrane Database Syst Rev. Jun 16 2010; (6): CD006321. PMID 20556765
- Scolapio JS. Effect of growth hormone, glutamine, and diet on body composition in short bowel syndrome: a randomized, controlled study. JPEN J Parenter Enteral Nutr. Nov-Dec 1999; 23(6): 309-12; discussion 312-3. PMID 10574477

- Seguy D, Vahedi K, Kapel N, et al. Low-dose growth hormone in adult home parenteral nutritiondependent short bowel syndrome patients: a positive study. Gastroenterology. Feb 2003; 124(2): 293-302. PMID 12557135
- 59. Szkudlarek J, Jeppesen PB, Mortensen PB. Effect of high dose growth hormone with glutamine and no change in diet on intestinal absorption in short bowel patients: a randomised, double blind, crossover, placebo controlled study. Gut. Aug 2000; 47(2): 199-205. PMID 10896910
- 60. Maiorana A, Cianfarani S. Impact of growth hormone therapy on adult height of children born small for gestational age. Pediatrics. Sep 2009; 124(3): e519-31. PMID 19706577
- Lindboe JB, Langkilde A, Eugen-Olsen J, et al. Low-dose growth hormone therapy reduces inflammation in HIV-infected patients: a randomized placebo-controlled study. Infect Dis (Lond). Nov-Dec 2016; 48(11-12): 829-37. PMID 27417288
- Wanke C, Gerrior J, Kantaros J, et al. Recombinant human growth hormone improves the fat redistribution syndrome (lipodystrophy) in patients with HIV. AIDS. Oct 22 1999; 13(15): 2099-103. PMID 10546863
- Bryant J, Baxter L, Cave CB, et al. Recombinant growth hormone for idiopathic short stature in children and adolescents. Cochrane Database Syst Rev. Jul 18 2007; (3): CD004440. PMID 17636758
- 64. Deodati A, Cianfarani S. Impact of growth hormone therapy on adult height of children with idiopathic short stature: systematic review. BMJ. Mar 11 2011; 342: c7157. PMID 21398350
- 65. Paltoglou G, Dimitropoulos I, Kourlaba G, et al. The effect of treatment with recombinant human growth hormone (rhGH) on linear growth and adult height in children with idiopathic short stature (ISS): a systematic review and meta-analysis. J Pediatr Endocrinol Metab. Dec 16 2020; 33(12): 1577-1588. PMID 33035189
- 66. Idiopathic short stature: results of a one-year controlled study of human growth hormone treatment. Genentech Collaborative Study Group. J Pediatr. Nov 1989; 115(5 Pt 1): 713-9. PMID 2681637
- 67. Ackland FM, Jones J, Buckler JM, et al. Growth hormone treatment in non-growth hormone-deficient children: effects of stopping treatment. Acta Paediatr Scand Suppl. 1990; 366: 32-7. PMID 2206005
- Cowell CT. Effects of growth hormone in short, slowly growing children without growth hormone deficiency. Australasian Paediatric Endocrine Group. Acta Paediatr Scand Suppl. 1990; 366: 29-30; discussion 31. PMID 2206004
- 69. Leschek EW, Rose SR, Yanovski JA, et al. Effect of growth hormone treatment on adult height in peripubertal children with idiopathic short stature: a randomized, double-blind, placebo-controlled trial. J Clin Endocrinol Metab. Jul 2004; 89(7): 3140-8. PMID 15240584
- McCaughey ES, Mulligan J, Voss LD, et al. Growth and metabolic consequences of growth hormone treatment in prepubertal short normal children. Arch Dis Child. Sep 1994; 71(3): 201-6. PMID 7979491
- 71. Barton JS, Gardineri HM, Cullen S, et al. The growth and cardiovascular effects of high dose growth hormone therapy in idiopathic short stature. Clin Endocrinol (Oxf). Jun 1995; 42(6): 619-26. PMID 7634503
- 72. Soliman AT, abdul Khadir MM. Growth parameters and predictors of growth in short children with and without growth hormone (GH) deficiency treated with human GH: a randomized controlled study. J Trop Pediatr. Oct 1996; 42(5): 281-6. PMID 8936959
- 73. Kamp GA, Waelkens JJ, de Muinck Keizer-Schrama SM, et al. High dose growth hormone treatment induces acceleration of skeletal maturation and an earlier onset of puberty in children with idiopathic short stature. Arch Dis Child. Sep 2002; 87(3): 215-20. PMID 12193430
- 74. Volta C, Bernasconi S, Tondi P, et al. Combined treatment with growth hormone and luteinizing hormone releasing hormone-analogue (LHRHa) of pubertal children with familial short stature. J Endocrinol Invest. Nov 1993; 16(10): 763-7. PMID 8144848
- 75. McCaughey ES, Mulligan J, Voss LD, et al. Randomised trial of growth hormone in short normal girls. Lancet. Mar 28 1998; 351(9107): 940-4. PMID 9734940
- Albertsson-Wikland K, Aronson AS, Gustafsson J, et al. Dose-dependent effect of growth hormone on final height in children with short stature without growth hormone deficiency. J Clin Endocrinol Metab. Nov 2008; 93(11): 4342-50. PMID 18728172
- 77. Hindmarsh PC, Brook CG. Effect of growth hormone on short normal children. Br Med J (Clin Res Ed). Sep 05 1987; 295(6598): 573-7. PMID 3117236
- 78. Wit JM, Rietveld DH, Drop SL, et al. A controlled trial of methionyl growth hormone therapy in prepubertal children with short stature, subnormal growth rate and normal growth hormone response to secretagogues. Dutch Growth Hormone Working Group. Acta Paediatr Scand. May 1989; 78(3): 426-35. PMID 2662700

- 79. Volta C, Ghizzoni L, Muto G, et al. Effectiveness of growth-promoting therapies. Comparison among growth hormone, clonidine, and levodopa. Am J Dis Child. Feb 1991; 145(2): 168-71. PMID 1994682
- 80. Lanes R. Effects of two years of growth hormone treatment in short, slowly growing non-growth hormone deficient children. J Pediatr Endocrinol Metab. Jul-Sep 1995; 8(3): 167-71. PMID 8521190
- 81. Tao S, Li G, Wang Q, et al. Efficacy and Safety of Human Growth Hormone in Idiopathic Short Stature. Indian J Pediatr. Jul 2015; 82(7): 625-8. PMID 25893526
- Zadik Z, Mira U, Landau H. Final height after growth hormone therapy in peripubertal boys with a subnormal integrated concentration of growth hormone. Horm Res. 1992; 37(4-5): 150-5. PMID 1490656
- Wit JM, Boersma B, de Muinck Keizer-Schrama SM, et al. Long-term results of growth hormone therapy in children with short stature, subnormal growth rate and normal growth hormone response to secretagogues. Dutch Growth Hormone Working Group. Clin Endocrinol (Oxf). Apr 1995; 42(4): 365-72. PMID 7750190
- 84. Hindmarsh PC, Brook CG. Final height of short normal children treated with growth hormone. Lancet. Jul 06 1996; 348(9019): 13-6. PMID 8691923
- Buchlis JG, Irizarry L, Crotzer BC, et al. Comparison of final heights of growth hormone-treated vs. untreated children with idiopathic growth failure. J Clin Endocrinol Metab. Apr 1998; 83(4): 1075-9. PMID 9543120
- Lopez-Siguero JP, Garcia-Garcia E, Carralero I, et al. Adult height in children with idiopathic short stature treated with growth hormone. J Pediatr Endocrinol Metab. Nov-Dec 2000; 13(9): 1595-602. PMID 11154155
- Coutant R, Rouleau S, Despert F, et al. Growth and adult height in GH-treated children with nonacquired GH deficiency and idiopathic short stature: the influence of pituitary magnetic resonance imaging findings. J Clin Endocrinol Metab. Oct 2001; 86(10): 4649-54. PMID 11600520
- 88. Wit JM, Rekers-Mombarg LT. Final height gain by GH therapy in children with idiopathic short stature is dose dependent. J Clin Endocrinol Metab. Feb 2002; 87(2): 604-11. PMID 11836292
- van Gool SA, Kamp GA, Odink RJ, et al. High-dose GH treatment limited to the prepubertal period in young children with idiopathic short stature does not increase adult height. Eur J Endocrinol. Apr 2010; 162(4): 653-60. PMID 20110402
- 90. Lopez-Siguero JP, Martinez-Aedo MJ, Moreno-Molina JA. Final height after growth hormone therapy in children with idiopathic short stature and a subnormal growth rate. Acta Pediatr. 1996;85:113-57.
- Shemesh-Iron M, Lazar L, Lebenthal Y, et al. Growth hormone therapy and short stature-related distress: A randomized placebo-controlled trial. Clin Endocrinol (Oxf). May 2019; 90(5): 690-701. PMID 30721549
- Ross JL, Sandberg DE, Rose SR, et al. Psychological adaptation in children with idiopathic short stature treated with growth hormone or placebo. J Clin Endocrinol Metab. Oct 2004; 89(10): 4873-8. PMID 15472178
- 93. Theunissen NC, Kamp GA, Koopman HM, et al. Quality of life and self-esteem in children treated for idiopathic short stature. J Pediatr. May 2002; 140(5): 507-15. PMID 12032514
- 94. Downie AB, Mulligan J, McCaughey ES, et al. Psychological response to growth hormone treatment in short normal children. Arch Dis Child. Jul 1996; 75(1): 32-5. PMID 8813867
- 95. Liu S, Liu Q, Cheng X, et al. Effects and safety of combination therapy with gonadotropin-releasing hormone analogue and growth hormone in girls with idiopathic central precocious puberty: a meta-analysis. J Endocrinol Invest. Oct 2016; 39(10): 1167-78. PMID 27225286
- Tuvemo T, Gustafsson J, Proos LA. Growth hormone treatment during suppression of early puberty in adopted girls. Swedish Growth Hormone Advisory Group. Acta Paediatr. Sep 1999; 88(9): 928-32. PMID 10519330
- Blue Cross Blue Shield Association Technology Evaluation Center (TEC). Recombinent Human Growth Hormone (GH) Therapy in Adults with Age-Related GH Deficiency. TEC Assessment. 2001;Tab 11. PMID
- Thaker V, Haagensen AL, Carter B, et al. Recombinant growth hormone therapy for cystic fibrosis in children and young adults. Cochrane Database Syst Rev. Jun 05 2013; (6): CD008901. PMID 23737090
- 99. Thaker V, Carter B, Putman M. Recombinant growth hormone therapy for cystic fibrosis in children and young adults. Cochrane Database Syst Rev. Dec 17 2018; 12: CD008901. PMID 30557452
- 100. Phung OJ, Coleman CI, Baker EL, et al. Recombinant human growth hormone in the treatment of patients with cystic fibrosis. Pediatrics. Nov 2010; 126(5): e1211-26. PMID 20921071
- 101. Stalvey MS, Anbar RD, Konstan MW, et al. A multi-center controlled trial of growth hormone treatment in children with cystic fibrosis. Pediatr Pulmonol. Mar 2012; 47(3): 252-63. PMID 21905270

- 102. Raman S, Grimberg A, Waguespack SG, et al. Risk of Neoplasia in Pediatric Patients Receiving Growth Hormone Therapy--A Report From the Pediatric Endocrine Society Drug and Therapeutics Committee. J Clin Endocrinol Metab. Jun 2015; 100(6): 2192-203. PMID 25839904
- 103. Grimberg A, Allen DB. Growth hormone treatment for growth hormone deficiency and idiopathic short stature: new guidelines shaped by the presence and absence of evidence. Curr Opin Pediatr. Aug 2017; 29(4): 466-471. PMID 28525404
- 104. Grimberg A, DiVall SA, Polychronakos C, et al. Guidelines for Growth Hormone and Insulin-Like Growth Factor-I Treatment in Children and Adolescents: Growth Hormone Deficiency, Idiopathic Short Stature, and Primary Insulin-Like Growth Factor-I Deficiency. Horm Res Paediatr. 2016; 86(6): 361-397. PMID 27884013
- 105. Gravholt CH, Andersen NH, Conway GS, et al. Clinical practice guidelines for the care of girls and women with Turner syndrome: proceedings from the 2016 Cincinnati International Turner Syndrome Meeting. Eur J Endocrinol. Sep 2017; 177(3): G1-G70. PMID 28705803
- 106. Fleseriu M, Hashim IA, Karavitaki N, et al. Hormonal Replacement in Hypopituitarism in Adults: An Endocrine Society Clinical Practice Guideline. J Clin Endocrinol Metab. Nov 2016; 101(11): 3888-3921. PMID 27736313
- 107. Sklar CA, Antal Z, Chemaitilly W, et al. Hypothalamic-Pituitary and Growth Disorders in Survivors of Childhood Cancer: An Endocrine Society Clinical Practice Guideline. J Clin Endocrinol Metab. Aug 01 2018; 103(8): 2761-2784. PMID 29982476
- 108. National Institute for Health and Care Excellence (NICE). Human growth hormone (somatropin) for growth failure in children [TA188]. 2010; https://www.nice.org.uk/guidance/ta188. Accessed August 16, 2021.
- 109. Yuen KCJ, Biller BMK, Radovick S, et al. AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS AND AMERICAN COLLEGE OF ENDOCRINOLOGY GUIDELINES FOR MANAGEMENT OF GROWTH HORMONE DEFICIENCY IN ADULTS AND PATIENTS TRANSITIONING FROM PEDIATRIC TO ADULT CARE. Endocr Pract. Nov 2019; 25(11): 1191-1232. PMID 31760824
- 110. Cohen P, Rogol AD, Deal CL, et al. Consensus statement on the diagnosis and treatment of children with idiopathic short stature: a summary of the Growth Hormone Research Society, the Lawson Wilkins Pediatric Endocrine Society, and the European Society for Paediatric Endocrinology Workshop. J Clin Endocrinol Metab. Nov 2008; 93(11): 4210-7. PMID 18782877
- 111. Deal CL, Tony M, Hoybye C, et al. GrowthHormone Research Society workshop summary: consensus guidelines for recombinant human growth hormone therapy in Prader-Willi syndrome. J Clin Endocrinol Metab. Jun 2013; 98(6): E1072-87. PMID 23543664
- 112. Allen DB, Backeljauw P, Bidlingmaier M, et al. GH safety workshop position paper: a critical appraisal of recombinant human GH therapy in children and adults. Eur J Endocrinol. Feb 2016; 174(2): P1-9. PMID 26563978
- 113. Collett-Solberg PF, Ambler G, Backeljauw PF, et al. Diagnosis, Genetics, and Therapy of Short Stature in Children: A Growth Hormone Research Society International Perspective. Horm Res Paediatr. 2019; 92(1): 1-14. PMID 31514194
- 114. Kaplowitz P, Bloch C, Sills IN, et al. Evaluation and Referral of Children With Signs of Early Puberty. Pediatrics. Jan 2016; 137(1). PMID 26668298
- 115. Skytrofa ™ [package insert]. Princeton, NJ: Ascendis Pharma Endocrinology, Inc.: 10/2022
- 116. Sogroya <sup>®</sup> [package insert]. Plainsboro, NJ: Novo Nordisk Inc.: 4/2023