The following information was generated from the
Hazardous Substances Data Bank (HSDB),
a database of the National Library of Medicine's TOXNET system
(http://toxnet.nlm.nih.gov) on December 14, 2008.

Query: CAS Registry Number: 58-22-0

1
NAME: TESTOSTERONE

HSN: 3398

RN: 58-22-0

HUMAN HEALTH EFFECTS:

HUMAN TOXICITY EXCERPTS:

/SIGNS AND SYMPTOMS/ Androgens are contraindicated during pregnancy. Studies in humans have shown that androgens cause masculinization of the external genitalia of the female fetus, including clitoromegaly, abnormal vaginal development, and fusion of genital folds to form a scrotal-like structure. The degree of masculinization is dose related. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

/SIGNS AND SYMPTOMS/ Hepatic neoplasms have been associated with long-term, high-dose androgen therapy in humans; some cases were irreversible after androgen withdrawal. This effect is more likely with oral methylated androgens. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

/SIGNS AND SYMPTOMS/ In males, oligospermia, azoospermia, or reduced sperm function or ejaculatory volume resulting in possible infertility may occur during high-dose therapy with androgens if spermatogenesis is suppressed by a negative feedback mechanism. In females treated with androgens, amenorrhea may result, impairing fertility. In both females and males, fertility usually returns following cessation of therapy in females and dosage reduction or discontinuation in males. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

/SIGNS AND SYMPTOMS/ Systematic studies to determine the risks of misuse and abuse of androgens have not been performed to date, but evidence from experience with legitimate medical use of the drugs and from case reports in athletes indicates that potential adverse effects in either gender include increased aggression and antisocial behavior (ëëroid rageíí); psychotic manifestations and affective disorders (e.g., manic episode, depression); changes in libido; adverse alterations in lipoprotein profiles and increased risk of cardiovascular disease (e.g., coronary artery disease, stroke, atherosclerosis); hepatotoxicity (e.g., abnormal liver function test results, liver tumors [hepatic adenomas, hepatocellular carcinoma], peliosis hepatis, jaundice); premature bone maturation and epiphyseal closure with resultant irreversible short stature when initiated in adolescents or younger children; possible increased risk of ruptured tendons and ligaments and of tendonitis; and

acne. Other potential adverse effects of androgens in males include gynecomastia, hair loss, testicular atrophy and sperm abnormalities (oligospermia, decreased motility, abnormal morphology, azoospermia), impotence, and prostatic enlargement with resultant difficulty in urinating. Other potential adverse effects in females include clitoral enlargement (which may be irreversible), menstrual irregularities, hirsutism, androgenetic alopecia, deepened voice, and breast atrophy. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2950]**PEER REVIEWED**

/SIGNS AND SYMPTOMS/ Androgenic effects including clitoral hypertrophy, labial fusion of the external genital fold to form a scrotal-like structure, abnormal vaginal development, and persistence of a urogenital sinus have occurred in the female offspring of women who were given androgens during pregnancy. The degree of masculinization is related to the amount of drug given to the woman and the age of the fetus; masculinization is most likely to occur in a female fetus when exposure to androgens occurs during the first trimester. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

/SIGNS AND SYMPTOMS/ Testosterone may cause fetal harm when administered to pregnant women. Androgenic effects including clitoral hypertrophy, labial fusion of the external genital fold to form a scrotal-like structure, abnormal vaginal development, and persistence of a urogenital sinus have occurred in the female offspring of women who were given androgens during pregnancy. The degree of masculinization is related to the amount of drug given to the woman and the age of the fetus; masculinization is most likely to occur in a female fetus when exposure to androgens occurs during the first trimester. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

/OTHER TOXICITY INFORMATION/ Hepatocellular carcinoma has reportedly occurred in patients receiving long-term therapy with high dosages of androgens. Regression of the tumor does not always occur following discontinuance of androgen therapy. Geriatric patients may be at increased risk of developing prostatic hypertrophy and carcinoma during androgen therapy, although the manufacturers state that conclusive evidence to support this risk is lacking. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

/OTHER TOXICITY INFORMATION/ Testosterone is contraindicated in males with carcinoma of the breast or known or suspected carcinoma of the prostate. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

DRUG WARNINGS:

Virilization, including deepening of the voice, hirsutism, and clitoral enlargement, occur commonly in females; these changes may not be reversible following discontinuance of the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

The possibility that testosterone could be transferred from patients treated with topical or transdermal preparations of the drug to their sexual partners or other individuals in close physical contact should be

considered. Certain testosterone transdermal systems have an occlusive backing (e.g., Androderm, Testoderm TTS) that prevents the partner from coming in contact with active ingredient in the system. However, scrotal transdermal systems (i.e., Testoderm with or with Adhesive) do not include such an occlusive backing, and the potential for transfer of testosterone to a sexual partner was 6 mcg (1/45th the daily endogenous testosterone production in females) in one study. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Vet: /testosterone/ may suppress production of sperm. Do not use any testosterone containing implants within 60 days of slaughtering animals, or in any lactating animals with milk being used for human consumption. [Rossoff, I.S. Handbook of Veterinary Drugs. New York: Springer Publishing Company, 1974., p. 585]**PEER REVIEWED**

Testosterone shares the toxic potentials of other androgens, and the usual precautions of androgen therapy should be observed. When testosterone esters are used in combination with estrogens, the usual precautions associated with estrogen therapy should also be observed. Clinicians prescribing estrogens should be aware of the risks associated with use of these drugs and the manufacturers' labeling should be consulted for further discussion of these risks and associated precautions. Patients receiving a testosterone ester in combination with an estrogen should be given a copy of the patient labeling for the combination. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Testosterone should be used with caution in patients with cardiac, renal, or hepatic dysfunction since edema, with or without congestive heart failure, may occur as a result of sodium and water retention. If edema occurs during testosterone therapy and it is considered a serious complication, the drug should be discontinued; diuretic therapy may also be necessary. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Females should be carefully monitored for signs of virilization (eg, deepening of the voice, hirsutism, clitoromegaly, menstrual irregularities) during testosterone therapy. The drug should generally be discontinued when mild virilization is evident, since some adverse androgenic effects (eg, voice changes) may not subside following discontinuance of the drug. The woman and physician may decide that some virilization is acceptable during treatment for carcinoma of the breast. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Males should be carefully monitored for the development of priapism or excessive sexual stimulation since these are signs of excessive dosage. Males, especially geriatric patients, may become overly stimulated. Stimulation to the point of increasing the nervous, mental, and physical activities beyond the patient's cardiovascular capacity should be avoided when testosterone is used to treat climacteric in males. Geriatric males may be at increased risk of developing prostatic hypertrophy and carcinoma during androgen therapy. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Adult or adolescent males should be advised to report too frequent or persistent penile erections to their physician. Females should be advised

to report hoarseness, acne, menstrual changes, or the growth of facial hair to their physician. All patients should be advised to report nausea, vomiting, changes in skin color, or ankle swelling to their physician. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 1922]**PEER REVIEWED**

Patients receiving high dosages of testosterone should have periodic hemoglobin and hematocrit determinations, since polycythemia may occur. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Testosterone is contraindicated in males with carcinoma of the breast or known or suspected carcinoma of th prostate. Some manufacturers state that the drug is also contraindicated in patients with cardiac, renal, or hepatic decompensation; hypercalcemia; impaired liver function; and in patients who are easily sexually stimulated. Other manufacturers state that the drug is also contraindicated in patients with serious cardiac, renal, or hepatic disease and in patients with known hypersensitivity to the drug. Because of the potential risk of serious adverse health effects, testosterone should not be used for enhancement of athletic performance or physique. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Androgens should be used with extreme caution in children and only by specialists who are aware of the adverse effects of these drugs on bone maturation. Testosterone should be used cautiously to stimulate puberty, and only in carefully selected males with delayed puberty. (See Uses: Uses in Males.) In children, testosterone may accelerate bone maturation without producing compensatory gain in linear growth. This adverse effect may result in compromised adult stature. The younger the child, the greater the risk of testosterone compromising final mature stature. If testosterone is administered to prepubertal children (eg, to stimulate puberty in males), the drug should be used with extreme caution, and radiographic examination of the hand and wrist should be performed every 6 months to determine me rate of bone maturation and to assess the effect of treatment on the epiphyseal centers. If testosterone is to be used to stimulate puberty in a male with delayed puberty, the potential risk of therapy should be fully discussed with the patient and his parents prior to initiation of the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Since the risks clearly outweigh the possible benefits in women who are or may become pregnant, testosterone is contraindicated in such women. Women who become pregnant while receiving the drug should be informed of the potential hazard to the fetus. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

It is not known whether testosterone is distributed into milk. Because of the potential for serious adverse reactions to androgens in nursing infants, a decision should be made whether to discontinue nursing or to not use testosterone, taking into account the importance of the drug to the woman. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

... Priapism or excessive sexual stimulation in males, especially geriatric patients, may occur. If priapism or excessive sexual stimulation

develops during testosterone therapy, the drug should be discontinued temporarily, since these are signs of excessive dosage; if therapy with testosterone is reinstituted, a lower dosage should be used. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2952]**PEER REVIEWED**

Hypercalcemia resulting from osteolysis, especially in immobile patients and those with metastatic carcinoma of the breast, has been reported in patients receiving testosterone. The drug should be discontinued if hypercalcemia occurs in patients with cancer, since this may indicate progression of metastases to the bone. Retention of water, sodium, chloride, potassium, and inorganic phosphates has also occurred in patients receiving the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Hepatocellular carcinoma has reportedly occurred in patients receiving long-term therapy with high dosages of androgens. Regression of the tumor does not always occur following discontinuance of androgen therapy. Geriatric patients may be at increased risk of developing prostatic hypertrophy and carcinoma during androgen therapy, although the manufacturers state that conclusive evidence to support this risk is lacking. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Adverse effects associated with testosterone are similar to those of other synthetic or natural androgens and include acne, flushing of the skin, gynecomastia, increased or decreased libido, habituation, and edema. In addition, gynecomastia frequently develops and occasionally persists in patients being treated for hypogonadism. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2952]**PEER REVIEWED**

Oligospermia and decreased ejaculatory volume may occur in males receiving excessive dosage or prolonged administration of the drug. ... Male pattern of baldness may also occur. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2952]**PEER REVIEWED**

Hypersensitivity reactions, including skin manifestations and anaphylactoid reactions, have occurred rarely with testosterone. Allergic contact dermatitis has been reported with topical administration (e.g., as transdermal systems) of testosterone. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Cholestatic hepatitis and jaundice and abnormal liver function test results have occurred in patients receiving androgens, principally 17-alpha-alkylandrogens such as fluoxymesterone or methyltestosterone. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Other adverse effects associated with testosterone therapy include nausea, chills and excitation. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Supraphysiologic concentrations of testosterone can stimulate erythropoiesis. Increased hematocrit and possibly adverse effects secondary to hyperviscosity may result. In addition, leukopenia, polycythemia, and suppression of clotting factors II, V, VII, and X also have occurred in patients receiving testosterone.. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Although the effect of testosterone on fertility in humans has not been conclusively determined, the drug produces oligospermia and decreased ejaculatory volume in males. Priapism and excessive sexual stimulation have also occurred in males receiving the drug. Increased or decreased libido has also been reported. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

FDA Pregnancy Risk Category: X /CONTRAINDICATED IN PREGNANCY. Studies in animals or humans, or investigational or post-marketing reports, have demonstrated positive evidence of fetal abnormalities or risk which clearly outweights any possible benefit to the patient./ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2750]**PEER REVIEWED**

The use of androgens for the prevention of postpartum breast engorgement is not recommended. In many patients, postpartum breast engorgement is a benign, self-limited condition that may respond to breast support and mild analgesics, such as acetaminophen and ibuprofen. Evidence supporting the efficacy of androgens for this indication is lacking. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Androgens are not recommended for accelerating the healing of fractures or shortening the duration of postsurgical convalescence. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Use of androgens to enhance athletic performance is illegal. Increases in muscle mass and muscle strength can be sufficient to enhance athletic performance. However, the risk of unwanted effects, such as suppression of spermatogenesis, testicular atrophy, menstrual disturbances, virilization in females, peliosis hepatis (hepatic parenchymal injury), hepatotoxicity, potential adverse effects on cardiovascular health, and development of hepatic cancer, counter athletic benefits received from androgens and make their use in athletes inappropriate. Furthermore, behavioral disturbances, including aggressive or violent behavior, have been reported with supraphysiological self-administered doses in athletics. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Treatment of male patients over the age of approximately 50 years with androgens should be preceded by a thorough examination of the prostate and baseline measurement of prostate-specific antigen serum concentration, since androgens may cause increased risk of prostatic hypertrophy or may

stimulate the growth of occult prostatic carcinoma. Periodic evaluation of prostate function should also be performed during the course of therapy. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

Use of androgens may increase or decrease blood glucose and produce an unfavorable profile of lipoprotein metabolism in patients without diabetes mellitus; a more exaggerated response can be expected in patients with diabetes mellitus, especially in obese patients. Effects may be greater for oral formulations or when pharmacologic doses of androgens are used. Doses of insulin or antidiabetic sulfonylurea medications may need to be adjusted, especially if hypoglycemia occurs. Physiologic doses of androgens rarely cause hypoglycemia or hyperglycemia. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 154]**PEER REVIEWED**

MEDICAL SURVEILLANCE:

SRP: Workers exposed to testosterone during its manufacture as well as patients receiving androgen therapy should be monitored for gynecomastia, hepatic, renal, and cardiac dysfunction, aggressive or antisocial behavior, lipoprotein profiles and priapism. **PEER REVIEWED**

POPULATIONS AT SPECIAL RISK:

Androgens are contraindicated during pregnancy. Studies in humans have shown that androgens cause masculinization of the external genitalia of the female fetus, including clitoromegaly, abnormal vaginal development, and fusion of genital folds to form a scrotal-like structure. The degree of masculinization is dose-related. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

Androgens should be used with caution in children and adolescents who are still growing because of possible premature epiphyseal closure in males and females, precocious sexual development in prepubertal males, or virilization in females. Skeletal maturation should be monitored at 6 month intervals by an x-ray of the hand and wrist. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

Testosterone is contraindicated in males with carcinoma of the breast or known or suspected carcinoma of the prostate. Some manufacturers state that the drug is also contraindicated in patients with cardiac, renal, or hepatic decompensation; hypercalcemia; impaired liver function; and in patients who are easily sexually stimulated. Other manufacturers state that the drug is also contraindicated in patients with serious cardiac, renal, or hepatic disease and in patients with known hypersensitivity to the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Anabolic steroids may decrease blood glucose concentrations; diabetic patients should be closely monitored for signs of hypoglycemia and dosage of hypoglycemic agent adjusted as necessary. /Anabolic steroids/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 141]**PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:
Occupational exposure to testosterone may occur through dermal contact with this compound at workplaces where testosterone is produced or used(SRC). Male workers who are exposed to testosterone during manufacturing and packing have shown effects from testosterone(1). Increased exposure to testosterone among the general population may be limited to those administered the drug, an androgenic steroid(SRC). Intentional human exposure may have occurred from testosterone use as a possible performance enhancement drug in athletes(2). [(1) Lewis RJ, ed; Sax's Dangerous Properties of of Industrial Materials. 10th ed. Vol 1-3 NY, NY: John Wiley & Sons Inc., p 3364 (1999) (2) Donahue JL, Lowenthal DT; Am J Ther 7: 365-73 (2000) ]**PEER REVIEWED**

EMERGENCY MEDICAL TREATMENT:

EMERGENCY MEDICAL TREATMENT:

<p>The following Overview, *** ANABOLIC STEROIDS ***, is relevant for this HSDB record chemical.
LIFE SUPPORT:
- This overview assumes that basic life support measures have been instituted.

CLINICAL EFFECTS:
0.2.1 SUMMARY OF EXPOSURE
A) Toxicity is unlikely following acute overdose. Chronic exposure to high doses may result in androgenic effects.
B) Prolonged administration of high doses may cause androgenic effects (i.e., acne, hirsutism, or hoarseness). The most commonly reported side effects were increased libido (61%), changes in mood (48%), reduced testicular volume (46%), and acne (43%). Gynecomastia, disturbances in menstrual patterns, and spermatogenesis failure may also occur.
1) Other effects may include edema, cardiac abnormalities, changes in hormonal and lipid metabolism profiles, intrahepatic obstructive jaundice, cholestatic jaundice, neoplasia of the liver and hepatoma. A dependency syndrome and withdrawal have been described.

0.2.5 CARDIOVASCULAR
A) Myocardial infarction, hypertension, thrombosis, and sudden cardiac death have been seen with chronic misuse.

0.2.7 NEUROLOGIC
A) Choreiform movements and aggravation of nervous tics have been seen with chronic misuse.

0.2.8 GASTROINTESTINAL
A) Nausea and vomiting may occur.

0.2.9 HEPATIC

A) Cholestatic jaundice, hepatotoxicity, hepatocellular adenomas, and peliosis hepatitis have been reported with the therapeutic use of anabolic steroids.

0.2.10 GENITOURINARY

A) Hypogonadism, including decreased testicular size with aspermia, has been reported in hemodialysis patients who are taking chronic anabolic steroids therapeutically.

0.2.14 DERMATOLOGIC

A) Cystic acne, sebaceous cysts, furunculosis, and seborrheic dermatitis have occurred in persons using anabolic steroids.

0.2.15 MUSCULOSKELETAL

A) Growing children may develop premature fusion of the epiphyses of long bones, leading to permanent short stature.

0.2.16 ENDOCRINE

A) Abnormal hormone profiles have been noted in men and women who use steroids chronically.

0.2.17 METABOLISM

A) Lipoprotein profiles may be altered in adult women and men who chronically misuse steroids.

0.2.18 PSYCHIATRIC

A) Paranoid psychosis and mania have been described in abusers of anabolic steroids. Both manic and hypomanic episodes have been reported.

B) Increased aggressiveness, euphoria, depression, and delusions have been reported in patients taking anabolic steroids.

C) Withdrawal symptoms including craving, depressed mood, decreased libido, fatigue, decreased muscle size and strength have been reported in patients who chronically misuse steroids.

0.2.20 REPRODUCTIVE

A) Methandrostenolone has been shown to inhibit placental glucose-6-phosphatase in humans.

B) Administration of anabolic steroids during gestation may result in masculinisation of the urogenital sinus and clitoral hypertrophy. Premature bone maturation and decreased birthweight have been reported.

LABORATORY:

A) Blood anabolic steroid levels are not clinically useful.

TREATMENT OVERVIEW:

0.4.2 ORAL/PARENTERAL EXPOSURE

A) Toxicity has been reported only after chronic use. Gastrointestinal decontamination is generally not needed after acute ingestion unless another toxic co-ingestant is involved. As a group, they are primarily inactive orally because of extensive first pass hepatic metabolism.

B) Toxicity is unlikely following acute exposure.

C) Toxicity and withdrawal symptoms are possible following discontinuation of medication following chronic over exposure/ abuse.

RANGE OF TOXICITY:

A) Variable depending on particular drug and the individual.

ANTIDOTE AND EMERGENCY TREATMENT:

Treatment of overdose: Supportive care: Treatment should be symptomatic and supportive. [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2751]**PEER REVIEWED**

Basic treatment: Establish a patent airway. Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if needed. Administer oxygen by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary ... . Monitor for shock and treat if necessary ... . Anticipate seizures and treat if necessary ... . For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport ... . Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool ... . Cover skin burns with dry sterile dressings after decontamination ... . /Poison A and B/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994., p. 139]**PEER REVIEWED**

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in respiratory arrest. Positive pressure ventilation techniques with a bag valve mask device may be beneficial. Monitor cardiac rhythm and treat arrhythmias as necessary ... . Start an IV with D5W /SRP: "To keep open", minimal flow rate/. Use lactated Ringer's if signs of hypovolemia are present. Watch for signs of fluid overload. Consider drug therapy for pulmonary edema ... . For hypotension with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload ... . Treat seizures with diazepam (Valium) ... . Use proparacaine hydrochloride to assist eye irrigation ... . /Poison A and B/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994., p. 139]**PEER REVIEWED**

ANIMAL TOXICITY STUDIES:

NON-HUMAN TOXICITY EXCERPTS:

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ The effects of testosterone and (17) beta-estradiol on the prostate of castrated rats were investigated by histopathological and immunocytochemical procedures. A significant increase in prostatic weight occurred after 6 wk treatment with testosterone alone and in combination with (17) beta-estradiol. The greatest increase in prostatic weight occurred after the administration of testosterone plus (17) beta-estradiol. Histopathologically, glandular hyperplasia of the prostate was noted, and the number of bromodeoxyuridine-positive cells showed a significant increase over that induced by testosterone alone. [Murakoshi M et al; Tokai J Exp Clin Med 17 (3-4): 133-7 (1992) ]**PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ N-acetylation participates in the biotransformation of hydrazine drugs and arylamine carcinogens to cytotoxic and carcinogenic products. Differences in acetylation capacity expressed in several mammalian species, including humans and mice, are associated with differences in toxicity and carcinogenicity from these chemicals. The present study examines the influence of genotype, age and sex on kidney N-acetyltransferase activity in C57BL/6J (B6) and A/J inbred mouse strains using p-aminobenzoic acid as a substrate. There were no strain differences in kidney p-aminobenzoic acid N-acetyltransferase activity. However, within these strains, males have greater kidney N-acetyltransferase activity than females. A 2 fold increase in kidney N-acetyltransferase activity of males was evident by 30 days postnatally and persisted into maturity ( > 200 days after birth), whereas the kidney N-acetyltransferase activity of females remained unchanged. Castration reduced male kidney N-acetyltransferase to female levels, whereas testosterone replacement restored original levels of activity. Ovariectomized females exhibited the same enzyme activity as intact females. Testosterone increased kidney N-acetyltransferase activity

in females, but not in intact males. Estradiol decreased kidney N-acetyltransferase in males, but had no effect on female N-acetyltransferase activity. The data suggest that the increase in kidney N-acetyltransferase activity in male mice that accompanies development is under androgenic control. This idea is further supported by the finding that the kidney N-acetyltransferase activity of androgen-insensitive tfm/y mice is significantly less than the activity of either females or males sharing the same genetic background. These observations may explain, in part, the higher susceptibility of male mice to 2-acetylaminofluorene mutagenicity and carcinogenicity. [Smolen TN et al; J Pharmacol Exp Ther 264 (2): 854-8 (1993) ]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Of female BALB/cCrgl mice injected subcutaneously with 25 ug testosterone in water daily for the first five days after birth, 7/9 developed hyperplastic epithelial lesions, resembling epidermoid carcinomas (vaginal squamoua-cell tumors), at about 71 weeks of age. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 533 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Daily subcutaneous injections into virgin female BALB/cfC3H mice (MTV+) of 5 or 20 ug testosterone in 0.02 mL sesame oil for the first five days of postnatal life resulted in an increased mammary tumor incidence by 16 months of age (42/49 and 22/35), compared with mice treated with estradiol-17beta (8/35 and 32/64) or with ovine prolactin, bovine growth hormone or the vehicle (0/40 and 9/43). The mean age at onset of tumors of testosterone-treated mice was lower than that of those treated with estradiol-17beta (8.5 months versus 11.0 months). [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 533 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Twenty female albino rats were given subcutaneous injections of 0.5 mg testosterone propionate in arachis oil weekly from the age of three days, the doses being increased to 1 mg when they were 21 days old and to 2.5 mg when they were six months of age. Nine rats died during the first six months. Of 10 rats that survived 16 months or more of continuous treatment, three had theca-cell ovarian tumors. The pituitaries were not enlarged, but there was marked epithelial hyperplasia in the uteri of 5/10 rats. Neither ovarian nor uterine tumors occurred in untreated rats of that colony. /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 533 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Short term treatment of rats with chemical carcinogens produces a low incidence (5-15%) of prostate cancer, provided that prostatic cell proliferation is enhanced during carcinogen exposure. Chronic treatment with testosterone also produces a low prostate carcinoma incidence. A high carcinoma incidence can only be produced by chronic treatment with testosterone following administration of carcinogens such as N-methyl-N-nitrosourea and 3,2'-dimethyl-4-aminobiphenyl. Testosterone markedly enhances prostate carcinogenesis even at doses that do not measurably increase circulating testosterone. Thus, testosterone is a strong tumor promoter for the rat prostate. All such N-methyl-N- nitrosourea or 3,2'-dimethyl-4-aminobiphenyl initiated and/or testosterone promoted tumors are adenocarcinomas; most originate from the dorsolateral and anterior, but not ventral, prostate lobes. These tumors share a number of important characteristics with human prostate cancer. A high frequency (70%) of activation of the K-ras gene by a G35 to A mutation occurs in

these carcinomas. Another high incidence prostate carcinogenesis model, representing a different pathogenetic pathway, involves chronic administration of estradiol-(17) beta to rats in combination with low dose testosterone. The resulting carcinomas are low grade and originate exclusively from periurethral ducts of the dorsolateral and anterior prostate. While it is unknown whether testosterone is a tumor promoter in this system, preliminary studies indicate the formation of a DNA adduct in the target tissue, which suggests that estradiol-(17) beta acts as a tumor initiating agent in this system. [Bosland MC; J Cell Biochem Suppl 16H: 89-98 (1992) ]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Cervical-uterine tumors were found in 26/42 (C57BL ◊ dba)F1 mice implanted with 1-2-mg pellets of testosterone propionate twice weekly for lifespan. The tumors were infiltrating and metastasized to the lungs in 10 mice. /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 532 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Nb strain male rats received subcutaneous implants of one to three 10-mg pellets containing testosterone propionate:cholesterol in a ratio of 9:1. The pellets were replaced at 6-8 week intervals for as long as 91 weeks. Only rats treated for six months or more and in which pellets were replaced at least four times were included in the data. Incidences of prostatic carcinoma were 0/13, 5/30 and 11/55 in rats receiving one, two and three pellets, respectively. The incidence in untreated rats of this strain is 0.48% (2/409). The ages at onset of tumours were 48-78 and 37-89 weeks in rats treated with two and three pellets, respectively. /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 532 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Male A X C rats were castrated at 12 or 52 weeks of age and given subcutaneous implants of pellets containing testosterone propionate:cholesterol (1:3) to give a dose of 200 mg/kg bw testosterone. Two weeks later, all were fed 0.025% N-2-fluorenyldiacetamide for four weeks followed by one week on the basal diet, until the carcinogen had been administered for 16 weeks. Animals were killed after 48 weeks. In rats implanted when 12 weeks old, testosterone propionate resulted in a significantly increased incidence of liver carcinomas when compared with controls given N-2-fluorenyldiacetamide alone (25/25 versus 10/26; p = 0.001). A less marked but still significant effect of testosterone propionate was observed in rats 52 weeks old at the start of treatment (7/25 versus 0/27; p = 0.001). /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 532 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Two subcutaneous implantations at a five-month interval of pellets containing 100 mg testosterone propionate and 25 mg diethylstilbestrol dipropionate into hamsters resulted in the induction of leiomyomas and leiomyosarcomas along the uterine horns in 18/20 females and of similar tumors in the epididymis of 17/20 males. These tumors appeared after the 11th month; two females and three males died without tumors before that time. No concurrent controls were used. /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 533 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ In female Sprague-Dawley rats, a single subcutaneous injection of 1 mg testosterone propionate in 0.05 mL sesame oil at two days of age enhanced the incidence of auditory sebaceous gland tumors induced by DMBA administered intragastrically at 50 days of age. The incidences of tumors 250 days after DMBA treatment were 8/32 and 1/20 in the experimental and control groups, respectively ($p < 0.05$). /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 534 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Daily subcutaneous injections for 4-8 days of total doses of 0.5-80 mg testosterone into rats between days 10 and 20 of gestation and of total doses of 1-55 mg testosterone propionate between days 12 and 19 of gestation resulted in resorptions, necrosis, lethality, post-partum mortality and various degrees of masculinization in female offspring; the effects were correlated directly with dosage and period of administration. /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 535 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Injection of 100 mg testosterone propionate on day 14 of gestation into rats induced small or absent mammary glands in male and female offspring and absence of nipples in 100% of females only. /Testosterone propionate/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 535 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ A single subcutaneous injection of 4 mg/kg bw testosterone to rats between days 5 and 8 of gestation prevented implantation in 11/16 animals; injections on days 9-11 produced fetal loss or delayed parturition in 9/13 rats. Injection of 20 mg/kg bw on days 1, 5 or 9 led to fetal loss in all animals treated. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 535 (1979)]**PEER REVIEWED**

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Most sexual dimorphisms in reproductive behavior are hormonally organized in the guinea pig. The study sought to determine whether the sexually dimorphic requirement for the aromatization of testosterone in the activation of mounting is organized by testosterone prenatally and whether aromatization of testosterone contributes to the organization of mounting behavior. Pregnant females were treated with testosterone, the aromatase inhibitor ATD, or vehicle from days 28-65 of gestation. The offspring were gonadectomized and tested as adults for lordosis and androgen-activated mounting behavior. Prenatal testosterone treatments altered the hormonal requirements for androgen-activated mounting in females such that they resembled normal males, and did not require aromatization as adults. Prenatal inhibition of aromatase activity decreased mounting activity in females but not in males. This treatment had no influence on lordosis in either sex. The results support the hypothesis that the same hormones that activate mounting behavior in the adult guinea pig are responsible for the organization of mounting behavior. [Roy MM; Physiol Behav 51 (1): 105-9 (1992) ]**PEER REVIEWED**

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Testosterone propionate, cortisone, or sesame oil vehicle were given to rats during

the last week of pregnancy so that effects of the hormones on anogenital distance, breeding capacity and vaginal opening of the female progeny could be contrasted. Testosterone significantly increased anogenital distance and delayed vaginal opening of progeny. When females that had been exposed to testosterone in utero were tested for breeding capacity, a significantly smaller number mated than in the control group. Female rats that had been exposed to cortisone in utero exhibited premature vaginal opening but did not differ from controls in anogenital distance, and, unlike the testosterone exposed rats, mated. Results indicate that testosterone administration to rats during pregnancy is far more detrimental to the development and subsequent function of the reproductive system of female progeny than cortisone and suggest that similar changes which occur in response to maternal stress or to administration of adrenocorticotropic hormone during pregnancy are more likely to result from increases in testosterone than from increases in glucocorticoid secretion. /Testosterone propionate/ [McCoy SJ, Shirley BA; Life Sci 50 (9): 621-8 (1992) ]**PEER REVIEWED**

/ALTERNATIVE IN VITRO TESTS/ We tested whether exposure to anabolic-androgenic steroids (AASs) would induce apoptosis in adult rat ventricular myocytes in vitro. Myocytes were exposed to stanozolol (STZ), testosterone enanthate (TE) and testosterone (T) (0.1 umol/L, 1 umol/L, 10 umol/L, and 100 umol/L) for 20 h. The percentage of myocytes undergoing apoptosis was determined by terminal deoxynucleotidyl transferase-mediated nick end labeling (TUNEL) and was found to be increased when compared to control myocytes at STZ 10 umol/L 12 + or - 2% (mean + or - SD), STZ 100 umol/L 42 + or - 3%; TE 1 umol/L 11 + or - 2%, TE 10 umol/L 21 + or - 3%, TE 100 umol/L 62 + or - 2%; T 10 umol/L 11 + or - 2%, T 100 umol/L 40 + or - 3% (P < 0.001 vs. CTL 2 + or - 2%). The STZ-, TE- and T-induced dose-dependent apoptotic cell death was corroborated by a significantly increased DNA laddering in myocytes exposed to STZ and T > or = 10 umol/L and TE > or = 1 umol/L. Notably, STZ, TE, and T exposure markedly increased the expression of the pro-apoptotic oncogene Bax-alpha, as assessed by reverse transcription-polymerase chain reaction. Taken together, these results clearly show for the first time that AASs induce apoptotic cell death in a dose-dependent manner. This finding may have important implications in understanding the pathogenesis of ventricular remodeling, cardiomyopathy, and sudden cardiac death associated with AAS abuse. [Zaugg M et al; J Cell Physiol 187 (1): 90-5 (2001) ]**PEER REVIEWED** <a href="http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&dopt=Abstract&list_uids=11241353&query_hl=29" target=new>PubMed Abstract

METABOLISM/PHARMACOKINETICS:

METABOLISM/METABOLITES:

Extensive reductive metabolism of testosterone occurs not only in the liver, but also in a variety of extrahepatic tissues, especially in target organs of the sex hormones; the ultimately effective physiological androgen is formed in the target tissues. Testosterone metabolism occurs not only in the prostate and seminal vesicles but also in rat uterus, rabbit placenta, rodent testis and primate brain. In rats, the small intestine is also capable of metabolizing testosterone. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 536 (1979)]**PEER REVIEWED**

It is transformed to 5-alpha-dehydrotestosterone in target organs such as the prostate, sebaceous glands and seminal vesicles; only the latter compound binds to the androgen-receptor site in these target organs. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals

to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 536 (1979)]**PEER REVIEWED**

Large quantitative differences in testosterone metabolism are evident between female and male rats. The reason for this phenomenon is that many steroid-metabolizing enzymes in rats are either androgen- or estrogen-dependent; the sex hormones thus act in an inductive or a repressive manner. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 536 (1979)]**PEER REVIEWED**

Esters of testosterone, such as the propionate, the heptanoate, the cypionate, the valerate, the isovalerate, the enanthate and the undecanoate, are partially cleaved in vivo to release the parent compound. This has been demonstrated by oral administration of testosterone undecanoate in oily solution to rats: most of the compound is converted within the intestinal wall, the first step being partial splitting off of the fatty acid moiety. The non-metabolized portion, however, and the metabolite 5-alpha-dihydrotestosterone undecanoate, are absorbed via the lymphatic system and made available for androgenic action to the organism. /Testosterone esters/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 537 (1979)]**PEER REVIEWED**

Testosterone is metabolized principally in the liver to various 17-ketosteroids via 2 different pathways. Testosterone and its metabolites are also conjugated with glucuronic and sulfuric acid. Testosterone and its metabolites are excreted in urine and feces. Approximately 90% of a dose of testosterone is excreted in urine as glucuronic and sulfuric acid conjugates of the drug and its metabolites; approximately 6% of a dose is excreted in feces, principally as unconjugated drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2955]**PEER REVIEWED**

Presence of 17-alpha alkyl group reduces susceptibility to hepatic enzyme degradation, which slows metabolism and allows oral administration. [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 152]**PEER REVIEWED**

ABSORPTION, DISTRIBUTION & EXCRETION:

Testosterone is absorbed systemically through the skin following topical application as a gel or transdermal system. Following topical application of a hydroalcoholic gel formulation of testoterone (AndroGel 1%) to the skin, the gel quickly dries on the skin surface, which serves as a reservoir for sustained release of the hormone into systemic circulation. Approximately 10% of a testosterone dose applied topically to the skin as the 1% gel is absorbed percutaneously into systemic circulation. The manufacturer states that increases in serum testosterone concentrations were apparent within 30 minutes of topical application of a 100-mg testosterone dose of the 1% gel, with physiologic concentrations being achieved in most patients within 4 hours (pretreatment concentrations were not described); percutaneous absorption continues for the entire 24-hour dosing interval. Serum testosterone concentrations approximate steady-state levels by the end of the initial 24 hours and are at steady state by the second or third day of dosing of the 1% gel. With daily topical application of the 1% gel, serum testosterone concentrations 30, 90, and 180 days after initiating treatment generally are maintained in the eugonadal range. Following discontinuance of such topical therapy,

serum testosterone concentrations remain within the normal range for 24-48 hours but return to pretreatment levels by the fifth day after the last application. The manufacturer states that mean concentrations of the active metabolite dihydrotestosterone (DHT) were within or about 7% above the normal range 180 days after initiating daily topical application of 50 or 100 mg, respectively, of testosterone as the gel. Increases in DHT concentrations appeared to parallel those of testosterone, and the mean steady-state ratio of DHT to testosterone was maintained in the normal range during the 180-day treatment period. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Following subcutaneous implantation of testosterone pellets, approximately 33% of an implanted dose is absorbed systemically during the first month, 25% during the second month, and 17% during the third month. The duration of action of subcutaneous testosterone implants (pellets) is usually 3-4 months but occasionally may be up to 6 months. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Esterification of testosterone generally results in less polar compounds. The cypionate and enanthate esters of testosterone are absorbed slowly from the lipid tissue phase at the IM injection site, achieving peak serum concentrations about 72 hours after IM injection; thus, these esters have a prolonged duration of action (i.e., up to 2-4 weeks) following IM administration. Testosterone propionate, however, reportedly has a shorter duration of action than that of testosterone following IM administration. Because IM injection of testosterone or its esters causes local irritation, the rate of absorption may be erratic. /Testosterone esters/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

The distribution of bioactive and nonbioactive androgen is determined by the amount sex hormone binding globulin in the serum and the total testosterone level. [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2750]**PEER REVIEWED**

Elimination: Renal: about 90% excreted in urine as glucuronic and sulfuric acid conjugates of testosterone and its metabolites. Fecal: about 6% unconjugated form. [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2750]**PEER REVIEWED**

Duration of elevation of plasma testosterone levels following single dose of testosterone esters varies from testosterone propionate, with duration of 1-3 days, to testosterone enanthate with duration of 14 to 21 days ... . [Miller, R. R., and D. J. Greenblatt. Handbook of Drug Therapy. New York: Elsevier North Holland, 1979., p. 843]**PEER REVIEWED**

Following oral administration of testosterone, only small amounts of the drug reach systemic circulation unchanged. The low bioavailability of orally administered testosterone results from metabolism of the drug in the GI mucosa during absorption and on first pass through the liver. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

In serum, testosterone is bound with high affinity to SHBG and with low

affinity to albumin. The amount of SHBG in serum and the total testosterone concentration determine the distribution of pharmacologically active and non-active forms of the androgen. SHBG-binding capacity is high in prepubertal children, declines during puberty and adulthood, and increases again during the later decades of life. Approximately 30-40% of testosterone in plasma is bound to SHBG, 2% remains unbound (free), and the rest is bound to albumin and other proteins. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2955]**PEER REVIEWED**

Protein binding: Moderate (approximately 40% to sex hormone-binding globulin); 2% remains free and the rest is bound to albumin and other proteins. However, the albumin-bound testosterone easily dissociates and is presumed to be bioactive, while the portion bound to the sex hormone-binding globulin is not considered biologically active. [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2750]**PEER REVIEWED**

It is not known whether testosterone is distributed into milk. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

BIOLOGICAL HALF-LIFE:

The plasma half-life of testosterone reportedly ranges from 10-100 min. The plasma half-life of testosterone cypionate after IM injection is approximately 8 days. Testosterone released from testosterone transdermal systems has an apparent elimination half-life of 1.29 hours. ... [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2955]**PEER REVIEWED**

MECHANISM OF ACTION:

Androgens reportedly stimulate the production of erythrocytes, apparently by enhancing the production of erythropoietic stimulating factor.[McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

INTERACTIONS:

Concurrent testosterone and methadone on male rats showed improved neonatal survival of offspring. [SOYKA ET AL; DEV PHARMACOL THER 1 (2-3): 182 (1980) ]**PEER REVIEWED**

Testosterone may potentiate the action of oral anticoagulants, causing bleeding in some patients. When testosterone therapy is initiated in patients receiving oral anticoagulants, dosage reduction of the anticoagulant may be required to prevent an excessive hypoprothrombinemic response. Patients receiving oral anticoagulants should also be closely monitored when androgen therapy is discontinued. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Increased serum oxyphenbutazone concentrations have reportedly occurred in patients receiving androgens concurrently with oxyphenbutazone. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

The hormonal changes produced by the administration of ketoconazole are

dose dependent and fully reversible, with recovery from steroidogenic blockade 8 to 16 hr after an oral dose. Ketoconazole acts as an enzyme inhibitor to reduce the synthesis of cortisol and testosterone. The effects of ketoconazole on estrogen synthesis have not been fully clarified. The potent inhibitory action of ketoconazole on testosterone synthesis has been used with therapeutic benefit in the management of prostate cancer. The drug acts very quickly and has the advantage over other treatments currently employed of also decreasing adrenal androgen production. [Sonino N; N Engl J Med 317: 812-8 (1987)]**PEER REVIEWED**

PHARMACOLOGY:

THERAPEUTIC USES:

Androgens /systemic testosterone/ are primarily indicated in males as replacement therapy when congenital or acquired endogenous androgen absence or deficiency is associated with primary or secondary hypogonadism. Primary hypogonadism includes conditions such as: testicular failure due to cryptorchidism, bilateral torsion, orchitis, or vanishing testis syndrome; orchidectomy, Klinefelter's syndrome, chemotherapy, or toxic damage from alcohol or heavy metals. Hypogonadotropic hypogonadism (secondary hypogonadism) conditions include idiopathic gonadotropin or LHRH deficiency, or pituitary-hypothalamic injury as a result of tumors, trauma, or radiation and are the most common forms of hypogonadism seen in older adults. /Included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2750]**PEER REVIEWED**

Testosterone is used for the development and maintenance of secondary sexual characteristics in female-to-male transsexuals. /NOT included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Extemporaneously compounded topical testosterone is used for the treatment of itching resulting from lichen scierosus. /NOT included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Intramuscular preparations of testosterone and testosterone esters, and extemporaneously compounded topical testosterone are used in the treatment of microphallus. /NOT included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Male hypogonadism is a clinical situation characterised by a low serum testosterone level in combination with a diversity of symptoms and signs such as reduced libido and vitality, decreased muscle mass, increased fat mass and depression. Similar symptoms in combination with subnormal testosterone levels are seen in some elderly men. Several publications have suggested that testosterone treatment in hypogonadal men may have beneficial effects, but it is still uncertain whether testosterone substitution in the aging man is indicated. Despite this uncertainty the sale of testosterone have increased enormously over the last few years, hence it seems important to discuss what we now know about such treatment. The result from placebo-controlled studies of testosterone substitution in elderly men differ substantially, but it seems to improve, among other

things, bone mineral density, body composition, perception of physical strength, and maybe libido. In the short term there have been few problems or complications with testosterone treatment, but effects on the cardiovascular system and the prostate over the long term remain uncertain. Before any general recommendation could be given, big prospective studies have to be performed. Treatment should, however, be considered in men with testosterone in the hypogonadal range accompanied by clinical symptoms. Treatment needs to be individualized and should preferably be initiated by specialists in andrology, endocrinology or urology. [Svartberg J; Tidsskr Nor Laegeforen 125 (7): 879-82 (2005) ]**PEER REVIEWED**

Liver transplant recipients with allograft failure due to recurrent hepatitis C virus (HCV) infection often develop marked muscle wasting and ascites prior to death and are denied repeat liver transplantation. We sought to determine whether topical testosterone therapy is associated with improved muscle mass and survival in patients with chronic allograft failure post-liver transplant. We performed a retrospective review of liver transplant recipients with chronic allograft failure. Group 1 patients were treated for > 6 months with testosterone gel 1%; group 2 patients were untreated. Fourteen patients were identified with stage 3 or 4 fibrosis, muscle wasting, and allograft failure due to recurrent HCV. Group 1 (n=9) patients had statistically significant improvement in albumin, testosterone, muscle strength, well-being, and MELD/CTP scores, while there was no improvement seen for any of these parameters in group 2 (n=5). There were no deaths in group 1, while four of five patients in group 2 died on average 84 days posttransplant. Adverse effects of testosterone treatment included lower extremity edema (which resolved upon dose adjustment), hypertension, and pruritus. Topical testosterone gel appears to increase muscle strength, stimulate albumin synthesis, and improve survival in patients with allograft failure post-liver transplant. [Neff GW et al; Transplant Proc 36 (10): 3071-4 (2004) ]**PEER REVIEWED** <a href="http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&dopt=Abstract&list_uids=15686697" target=new>PubMed Abstract

... Testosterone cypionate or enanthate have been used to treat certain types of anemia, such as aplastic anemia, myelofibrosis, myelosclerosis, agnogenic myeloid metaplasia, and hypoplastic anemias caused by malignancy or myelotoxic drugs. /Testosterone cypionate or enanthate; Not included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Androgens are primarily indicated in males as replacement therapy when congenital or acquired endogenous androgen absence or deficiency is associated with primary hypogonadal or secondary hypogonadism. Primary hypogonadism includes conditions such as testicular failure due to cryptorchidism, bilateral torsion, orchitis, or vanishing testis syndrome; inborn errors in testosterone biosynthesis; or bilateral orchidectomy. Hypogonadotropic hypogonadism (secondary hypogonadism) conditions include gonadotropin releasing hormone (GnRH) deficiency; or pituitary hypothalamic injury as a result of surgery, tumors, trauma, or radiation and are the most common forms of hypogonadism seen in older adults. Dosage adjustment is needed to accommodate individual clinical requirements for such life changes as induction of puberty, development of secondary sexual characteristics, impotence due to testicular failure, or infertility due to oligospermia.. /Androgens; Included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 150]**PEER REVIEWED**

A 6 month or shorter course of an androgen is indicated for induction of puberty in patients with familial delayed puberty, a condition characterized by spontaneous, nonpathologic, late-onset puberty, if the patient does not respond to psychological treatment. /Androgens; Included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Androgens are used in the treatment of constitutional delay in growth. However, they are not longer considered the treatment of choice for most patients. /Androgens; NOT included in US product labeling/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

DRUG WARNINGS:

Virilization, including deepening of the voice, hirsutism, and clitoral enlargement, occur commonly in females; these changes may not be reversible following discontinuance of the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

The possibility that testosterone could be transferred from patients treated with topical or transdermal preparations of the drug to their sexual partners or other individuals in close physical contact should be considered. Certain testosterone transdermal systems have an occlusive backing (e.g., Androderm, Testoderm TTS) that prevents the partner from coming in contact with active ingredient in the system. However, scrotal transdermal systems (i.e., Testoderm with or with Adhesive) do not include such an occlusive backing, and the potential for transfer of testosterone to a sexual partner was 6 mcg (1/45th the daily endogenous testosterone production in females) in one study. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Vet: /testosterone/ may suppress production of sperm. Do not use any testosterone containing implants within 60 days of slaughtering animals, or in any lactating animals with milk being used for human consumption. [Rossoff, I.S. Handbook of Veterinary Drugs. New York: Springer Publishing Company, 1974., p. 585]**PEER REVIEWED**

Testosterone shares the toxic potentials of other androgens, and the usual precautions of androgen therapy should be observed. When testosterone esters are used in combination with estrogens, the usual precautions associated with estrogen therapy should also be observed. Clinicians prescribing estrogens should be aware of the risks associated with use of these drugs and the manufacturers' labeling should be consulted for further discussion of these risks and associated precautions. Patients receiving a testosterone ester in combination with an estrogen should be given a copy of the patient labeling for the combination. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Testosterone should be used with caution in patients with cardiac, renal, or hepatic dysfunction since edema, with or without congestive heart failure, may occur as a result of sodium and water retention. If edema occurs during testosterone therapy and it is considered a serious complication, the drug should be discontinued; diuretic therapy may also

be necessary.  [McEvoy, G.K. (ed.). American Hospital Formulary Service-Drug Information 2005. Bethesda, MD: American Society of  Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Females should be carefully monitored for signs of virilization (eg, deepening of the voice, hirsutism, clitoromegaly, menstrual irregularities) during testosterone therapy. The drug should generally be discontinued when mild virilization is evident, since some adverse androgenic effects (eg, voice changes) may not subside following discontinuance of the drug. The woman and physician may decide that some virilization is acceptable during treatment for carcinoma of the breast. [McEvoy, G.K. (ed.). American Hospital Formulary Service-  Drug Information 2005. Bethesda, MD: American Society of  Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Males should be carefully monitored for the development of priapism or excessive sexual stimulation since these are signs of excessive dosage. Males, especially geriatric patients, may become overly stimulated. Stimulation to the point of increasing the nervous, mental, and physical activities beyond the patient's cardiovascular capacity should be avoided when testosterone is used to treat climacteric in males. Geriatric males may be at increased risk of developing prostatic hypertrophy and carcinoma during androgen therapy.  [McEvoy, G.K. (ed.). American Hospital Formulary Service-  Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Adult or adolescent males should be advised to report too frequent or persistent penile erections to their physician. Females should be advised to report hoarseness, acne, menstrual changes, or the growth of facial hair to their physician. All patients should be advised to report nausea, vomiting, changes in skin color, or ankle swelling to their physician. [McEvoy, G.K. (ed.). American Hospital Formulary Service-  Drug Information 2005. Bethesda, MD: American Society of  Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 1922]**PEER REVIEWED**

Patients receiving high dosages of testosterone should have periodic hemoglobin and hematocrit determinations, since polycythemia may occur. [McEvoy, G.K. (ed.). American Hospital Formulary Service-  Drug Information 2005. Bethesda, MD: American Society of  Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Testosterone is contraindicated in males with carcinoma of the breast or known or suspected carcinoma of th prostate. Some manufacturers state that the drug is also contraindicated in patients with cardiac, renal, or hepatic decompensation; hypercalcemia; impaired liver function; and in patients who are easily sexually stimulated. Other manufacturers state that the drug is also contraindicated in patients with serious cardiac, renal, or hepatic disease and in patients with known hypersensitivity to the drug. Because of the potential risk of serious adverse health effects, testosterone should not be used for enhancement of athletic performance or physique. [McEvoy, G.K. (ed.). American Hospital Formulary Service-  Drug Information 2005. Bethesda, MD: American Society of  Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Androgens should be used with extreme caution in children and only by specialists who are aware of the adverse effects of these drugs on bone maturation. Testosterone should be used cautiously to stimulate puberty, and only in carefully selected males with delayed puberty. (See Uses: Uses in Males.) In children, testosterone may accelerate bone maturation without producing compensatory gain in linear growth. This adverse effect may result in compromised adult stature. The younger the child, the greater the risk of testosterone compromising final mature stature. If testosterone is administered to prepubertal children (eg, to stimulate

puberty in males), the drug should be used with extreme caution, and radiographic examination of the hand and wrist should be performed every 6 months to determine me rate of bone maturation and to assess the effect of treatment on the epiphyseal centers. If testosterone is to be used to stimulate puberty in a male with delayed puberty, the potential risk of therapy should be fully discussed with the patient and his parents prior to initiation of the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Since the risks clearly outweigh the possible benefits in women who are or may become pregnant, testosterone is contraindicated in such women. Women who become pregnant while receiving the drug should be informed of the potential hazard to the fetus. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

It is not known whether testosterone is distributed into milk. Because of the potential for serious adverse reactions to androgens in nursing infants, a decision should be made whether to discontinue nursing or to not use testosterone, taking into account the importance of the drug to the woman. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

... Priapism or excessive sexual stimulation in males, especially geriatric patients, may occur. If priapism or excessive sexual stimulation develops during testosterone therapy, the drug should be discontinued temporarily, since these are signs of excessive dosage; if therapy with testosterone is reinstituted, a lower dosage should be used. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2952]**PEER REVIEWED**

Hypercalcemia resulting from osteolysis, especially in immobile patients and those with metastatic carcinoma of the breast, has been reported in patients receiving testosterone. The drug should be discontinued if hypercalcemia occurs in patients with cancer, since this may indicate progression of metastases to the bone. Retention of water, sodium, chloride, potassium, and inorganic phosphates has also occurred in patients receiving the drug. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Hepatocellular carcinoma has reportedly occurred in patients receiving long-term therapy with high dosages of androgens. Regression of the tumor does not always occur following discontinuance of androgen therapy. Geriatric patients may be at increased risk of developing prostatic hypertrophy and carcinoma during androgen therapy, although the manufacturers state that conclusive evidence to support this risk is lacking. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Adverse effects associated with testosterone are similar to those of other synthetic or natural androgens and include acne, flushing of the skin, gynecomastia, increased or decreased libido, habituation, and edema. In addition, gynecomastia frequently develops and occasionally persists in patients being treated for hypogonadism. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p.

2952]**PEER REVIEWED**

Oligospermia and decreased ejaculatory volume may occur in males receiving excessive dosage or prolonged administration of the drug. ... Male pattern of baldness may also occur. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2952]**PEER REVIEWED**

Hypersensitivity reactions, including skin manifestations and anaphylactoid reactions, have occurred rarely with testosterone. Allergic contact dermatitis has been reported with topical administration (e.g., as transdermal systems) of testosterone. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Cholestatic hepatitis and jaundice and abnormal liver function test results have occurred in patients receiving androgens, principally 17-alpha-alkylandrogens such as fluoxymesterone or methyltestosterone. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Other adverse effects associated with testosterone therapy include nausea, chills and excitation. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Supraphysiologic concentrations of testosterone can stimulate erythropoiesis. Increased hematocrit and possibly adverse effects secondary to hyperviscosity may result. In addition, leukopenia, polycythemia, and suppression of clotting factors II, V, VII, and X also have occurred in patients receiving testosterone.. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2953]**PEER REVIEWED**

Although the effect of testosterone on fertility in humans has not been conclusively determined, the drug produces oligospermia and decreased ejaculatory volume in males. Priapism and excessive sexual stimulation have also occurred in males receiving the drug. Increased or decreased libido has also been reported. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

FDA Pregnancy Risk Category: X /CONTRAINDICATED IN PREGNANCY. Studies in animals or humans, or investigational or post-marketing reports, have demonstrated positive evidence of fetal abnormalities or risk which clearly outweights any possible benefit to the patient./ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 2750]**PEER REVIEWED**

The use of androgens for the prevention of postpartum breast engorgement is not recommended. In many patients, postpartum breast engorgement is a benign, self-limited condition that may respond to breast support and mild analgesics, such as acetaminophen and ibuprofen. Evidence supporting the efficacy of androgens for this indication is lacking. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States

Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Androgens are not recommended for accelerating the healing of fractures or shortening the duration of postsurgical convalescence. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Use of androgens to enhance athletic performance is illegal. Increases in muscle mass and muscle strength can be sufficient to enhance athletic performance. However, the risk of unwanted effects, such as suppression of spermatogenesis, testicular atrophy, menstrual disturbances, virilization in females, peliosis hepatis (hepatic parenchymal injury), hepatotoxicity, potential adverse effects on cardiovascular health, and development of hepatic cancer, counter athletic benefits received from androgens and make their use in athletes inappropriate. Furthermore, behavioral disturbances, including aggressive or violent behavior, have been reported with supraphysiological self-administered doses in athletics. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

Treatment of male patients over the age of approximately 50 years with androgens should be preceded by a thorough examination of the prostate and baseline measurement of prostate-specific antigen serum concentration, since androgens may cause increased risk of prostatic hypertrophy or may stimulate the growth of occult prostatic carcinoma. Periodic evaluation of prostate function should also be performed during the course of therapy. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 153]**PEER REVIEWED**

Use of androgens may increase or decrease blood glucose and produce an unfavorable profile of lipoprotein metabolism in patients without diabetes mellitus; a more exaggerated response can be expected in patients with diabetes mellitus, especially in obese patients. Effects may be greater for oral formulations or when pharmacologic doses of androgens are used. Doses of insulin or antidiabetic sulfonylurea medications may need to be adjusted, especially if hypoglycemia occurs. Physiologic doses of androgens rarely cause hypoglycemia or hyperglycemia. /Androgens/ [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 154]**PEER REVIEWED**

INTERACTIONS:

Concurrent testosterone and methadone on male rats showed improved neonatal survival of offspring. [SOYKA ET AL; DEV PHARMACOL THER 1 (2-3): 182 (1980) ]**PEER REVIEWED**

Testosterone may potentiate the action of oral anticoagulants, causing bleeding in some patients. When testosterone therapy is initiated in patients receiving oral anticoagulants, dosage reduction of the anticoagulant may be required to prevent an excessive hypoprothrombinemic response. Patients receiving oral anticoagulants should also be closely monitored when androgen therapy is discontinued. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Increased serum oxyphenbutazone concentrations have reportedly occurred in patients receiving androgens concurrently with oxyphenbutazone. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

The hormonal changes produced by the administration of ketoconazole are dose dependent and fully reversible, with recovery from steroidogenic blockade 8 to 16 hr after an oral dose. Ketoconazole acts as an enzyme inhibitor to reduce the synthesis of cortisol and testosterone. The effects of ketoconazole on estrogen synthesis have not been fully clarified. The potent inhibitory action of ketoconazole on testosterone synthesis has been used with therapeutic benefit in the management of prostate cancer. The drug acts very quickly and has the advantage over other treatments currently employed of also decreasing adrenal androgen production. [Sonino N; N Engl J Med 317: 812-8 (1987)]**PEER REVIEWED**

BIONECESSITY:

Androgens are responsible for the growth spurt that occurs during adolescence and for the eventual termination of linear growth that results from fusion of the epiphyseal growth centers. ... [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Testosterone, like other androgenic anabolic hormones, also produces retention of nitrogen, potassium, sodium, and phosphorus; increases protein anabolism; and decreases amino acid catabolism and urinary calcium concentrations. Nitrogen balance is improved only when there is sufficient intake of calories and protein. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Testosterone is the principal endogenous androgen. Endogenous androgens are essential hormones that are responsible for the normal growth and development of the male sex organs and for maintenance of secondary sex characteristics, including the growth and maturation of the prostate, seminal vesicles, penis, and scrotum; development of male hair distribution, such as beard, pubic, chest, and axillary hair; laryngeal enlargement and thickening of the vocal cords; and alterations in body musculature and fat distribution. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2954]**PEER REVIEWED**

Physiologic concentrations of androgens stimulate spermatogenesis and male sexual maturity at puberty, and develop and maintain male secondary sexual characteristics. These effects include growth and maturation of the prostate, seminal vesicles, penis, and scrotum: male hair and muscle-to-fate body mass distribution; enlargement of the larynx; and thickening of vocal cords. In children, exogenous androgens increase linear bone growth rates and help fuse the epiphyseal growth centers. An increase in bone growth rate can also correspond to a disproportionate advancement of bone maturation. [Thomson.Micromedex. Drug Information for the Health Care Professional. 25th ed. Volume 1. Plus Updates. Content Reviewed by the United States Pharmacopeial Convention, Inc. Greenwood Village, CO. 2005., p. 151]**PEER REVIEWED**

ENVIRONMENTAL FATE & EXPOSURE:

ENVIRONMENTAL FATE/EXPOSURE SUMMARY:

Testosterone's production and use as a male hormone and steroid as well as its possible use as a performance enhancement drug in athletes may result in its release to the environment through various waste streams. Testosterone is a principal hormone of the testes produced in interstitial cells. If released to air, an estimated vapor pressure of 1.7X10-8 mm Hg at 25 deg C indicates testosterone will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase testosterone will be removed from the atmosphere by wet and dry deposition. Testosterone does not absorb light at wavelengths > 290 nm and therefore should not be susceptible to direct photolysis by sunlight. If released to soil, testosterone is expected to have slight mobility based upon a Koc of 2,188. Volatilization from water and moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 3.5X10-9 atm-cu m/mole. Testosterone is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Within 24 hours 14C labeled testosterone was mineralized by both industrial and municipal sewage with greater than 50% and 60% mineralization, respectively. A sewage treatment plant removed 58-65% of testosterone from the influent, with 95% removal reported for the aqueous phase of treatment. These data suggest that biodegradation may be an important environmental fate process. If released into water, testosterone is expected to adsorb to suspended solids and sediment based upon the Koc. An estimated BCF of 72 suggests the potential for bioconcentration in aquatic organisms is moderate. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. Occupational exposure to testosterone may occur through dermal contact with this compound at workplaces where testosterone is produced or used. Monitoring data indicate that testosterone has been found in wastewater. Testosterone is a major circulating androgen and required for normal male sexual differentiation. Increased exposure to testosterone among the general population may be limited to those administered the drug, an androgenic steroid. Intentional human exposure may have occurred from testosterone use as a possible performance enhancement drug in athletes. (SRC) **PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:

Occupational exposure to testosterone may occur through dermal contact with this compound at workplaces where testosterone is produced or used(SRC). Male workers who are exposed to testosterone during manufacturing and packing have shown effects from testosterone(1). Increased exposure to testosterone among the general population may be limited to those administered the drug, an androgenic steroid(SRC). Intentional human exposure may have occurred from testosterone use as a possible performance enhancement drug in athletes(2). [(1) Lewis RJ, ed; Sax's Dangerous Properties of of Industrial Materials. 10th ed. Vol 1-3 NY, NY: John Wiley & Sons Inc., p 3364 (1999) (2) Donahue JL, Lowenthal DT; Am J Ther 7: 365-73 (2000) ]**PEER REVIEWED**

NATURAL POLLUTION SOURCES:

ISOLATION IN MINUTE AMT FROM TESTES, ESPECIALLY BULL TESTES. [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

Testosterone is a principal hormone of the testes produced in interstitial cells and required for male sexual differentiation(1). [(1) O'Neil MJ, ed; The Merck Index. 13th ed. Whitehouse Station, NJ: Merck and Co., Inc. p. 1638 (2001) ]**PEER REVIEWED**

ARTIFICIAL POLLUTION SOURCES:

Testosterone's production and use as a male hormone, steroid(1) and possible use as a performance enhancement drug(2) may result in its release to the environment through various waste streams(SRC). [(1) PDR; Physicians' Desk Reference 52nd ed 1998. Montvale,NJ: Medical Economics

Co. p. 3244 (2005) (2) Donahue JL, Lowenthal DT; Am J Ther 7: 365-73 (2000) ]**PEER REVIEWED**

ENVIRONMENTAL FATE:

TERRESTRIAL FATE: Based on a classification scheme(1), a Koc value of 2,188(2), indicates that testosterone is expected to have low mobility in soil(SRC). Volatilization of testosterone from moist soil surfaces is not expected to be an important fate process(SRC) given an estimated Henry's Law constant of 3.5X10-9 atm-cu m/mole(SRC), using a fragment constant estimation method(3). Testosterone is not expected to volatilize from dry soil surfaces(SRC) based upon an estimated vapor pressure of 1.7X10-8 mm Hg(SRC), determined from a fragment constant method(4). Sewage treatment plant removal rates of 58-65%(5,6) suggest that biodegradation may be an important environmental fate process in soil(SRC). [(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Lee LS et al Environ Sci Technol 37: 4098-105 (2003) (3) Meylan WM, Howard PH; Environ Toxicol Chem 10: 1283-93 (1991) (4) Lyman WJ; p. 31 in Environmental Exposure From Chemicals Vol I, Neely WB, Blau GE, eds, Boca Raton, FL: CRC Press (1985) (5) Layton AC et al; Environ Sci Technol 34: 3925-31 (2000) (6) Shore LS et al Bull Environ Contam Toxicol 51: 361-6 (1993) ]**PEER REVIEWED**

AQUATIC FATE: Based on a classification scheme(1), a Koc value of 2,188(2), indicates that testosterone is expected to adsorb to suspended solids and sediment(SRC). Volatilization from water surfaces is not expected(3) based upon an estimated Henry's Law constant of 3.5X10-9 atm-cu m/mole(SRC), developed using a fragment constant estimation method(4). According to a classification scheme(5), an estimated BCF of 72(SRC), from an a log Kow 3.32(6) and a regression-derived equation(7), suggests the potential for bioconcentration in aquatic organisms is moderate(SRC). Sewage treatment plant removal rates of 58-65%(8,9), with 95% removal reported for the aqueous phase of treatment(8) suggest that biodegradation may be an important environmental fate process in water(SRC). [(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Lee LS et al Environ Sci Technol 37:4098-4105 (2003) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9, 15-1 to 15-29 (1990) (4) Meylan WM, Howard PH; Environ Toxicol Chem 10: 1283-93 (1991) (5) Franke C et al; Chemosphere 29: 1501-14 (1994) (6) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 164 (1995) (7) Meylan WM et al; Environ Toxicol Chem 18: 664-72 (1999) (8) Shore LS et al; Bull Environ Contam Toxicol 51: 361-6 (1993) (9) Layton AC et al; Environ Sci Technol 34: 3925-31 (2000) ]**PEER REVIEWED**

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), testosterone, which has an estimated vapor pressure of 1.7X10-8 mm Hg at 25 deg C (SRC), determined from a fragment constant method(2), is expected to exist solely in the particulate phase in the ambient atmosphere. Particulate-phase testosterone may be removed from the air by wet and dry deposition(SRC). Testosterone does not absorb light at wavelengths > 290 nm(3) and therefore should not be susceptible to direct photolysis by sunlight(SRC). [(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988) (2) Lyman WJ; p. 31 in Environmental Exposure From Chemicals Vol I, Neely WB, Blau GE, eds, Boca Raton, FL: CRC Press (1985) (3) O'Neil MJ, ed; The Merck Index. 13th ed. Whitehouse Station, NJ: Merck and Co., Inc. p. 1638 (2001) ]**PEER REVIEWED**

ENVIRONMENTAL BIODEGRADATION:

AEROBIC: Testosterone, at a starting concentration of 99 ug/L, was mineralized over 24 hours to 14CO2 in four municipal treatment plants in the southeastern United States in amounts ranging from 55-65%; total removal from the aqueous phase of treatment was greater than 95%(1). The first order rate constant of 0.0152/min for this process(1) corresponds to

a biodegradation half-life of 32 days(SRC). Similar results, up to 58% mineralization, were obtained using industrial biosolids(1). Testosterone concentrations ranging from 0.8-1.1 nmol/L in raw sewage samples from Tel Aviv, Israel, were decreased to 0.2-0.5 nmol/L using anaerobic and aerobic digestion in a sewage disposal plant, corresponding to a 60-77% removal efficiency(2). [(1) Layton AC et al; Environ Sci Technol 34: 3925-3931 (2000) (2) Shore LS et al Bull Environ Contam Toxicol 51: 361-366 (1993) ]**PEER REVIEWED**

AEROBIC: Raw sewage effluent from Tel Aviv, Israel contained 0.8-1.1 nmol/L testesterone(1). After 3 months of percolation through sand, testosterone levels decreased to a nearly undetectable amount of 5 pmol/L(1). [(1) Shore LS et al Bull Environ Contam Toxicol 51: 361-366 (1993) ]**PEER REVIEWED**

ENVIRONMENTAL ABIOTIC DEGRADATION:
Testosterone is not expected to undergo hydrolysis in the environment due to the lack of hydrolyzable functional groups(1). Testosterone does not absorb light at wavelengths > 290 nm(2) and therefore should not be susceptible to direct photolysis by sunlight(SRC). [(1) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 7-4, 7-5 (1990) (2) O'Neil MJ, ed; The Merck Index. 13th ed. Whitehouse Station, NJ: Merck and Co., Inc. p. 1638 (2001) ]**PEER REVIEWED**

ENVIRONMENTAL BIOCONCENTRATION:
An estimated BCF of 72 was calculated for testosterone(SRC), using a log Kow of 3.32(1) and a regression-derived equation(2). According to a classification scheme(3), this BCF suggests the potential for bioconcentration in aquatic organisms is moderate(SRC), provided the compound is not metabolized by the organism(SRC). [(1) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 164 (1995) (2) Meylan WM et al; Environ Toxicol Chem 18: 664-72 (1999) (3) Franke C et al; Chemosphere 29: 1501-14 (1994) ]**PEER REVIEWED**

SOIL ADSORPTION/MOBILITY:
The soil absorption of testosterone was measured in several different soil samples(1). Log Koc values ranging from 3.25-3.52 were measured(1). The average log Koc was 3.32 and corresponds to a Koc value of 2,188(1). According to a classification scheme(2), this estimated Koc value suggests that testosterone is expected to have low mobility in soil. [(1) Lee LS et al Environ Sci Technol 37: 4098-105 (2003) (2) Swann RL et al; Res Rev 85: 17-28 (1983) ]**PEER REVIEWED**

VOLATILIZATION FROM WATER/SOIL:
The Henry's Law constant for testosterone is estimated as 3.5X10-9 atm-cu m/mole(SRC) using a fragment constant estimation method(1). This Henry's Law constant indicates that testosterone is expected to be essentially nonvolatile from moist soil(SRC) and water surfaces(2). Testosterone is not expected to volatilize from dry soil surfaces(SRC) based upon an estimated vapor pressure of 1.7X10-8 mm Hg(SRC), determined from a fragment constant method(3). [(1) Meylan WM, Howard PH; Environ Toxicol Chem 10: 1283-93 (1991) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990) (3) Lyman WJ; p. 31 in Environmental Exposure From Chemicals Vol I, Neely WB, Blau GE, eds, Boca Raton, FL: CRC Press (1985) ]**PEER REVIEWED**

ENVIRONMENTAL WATER CONCENTRATIONS:
GROUNDWATER: Testosterone has been detected in concentration of 1.0 ng/L in ground water from drilled sampling wells on farms that had used chicken manure fertilizer for over 5 years(1). [(1) Drewes JE, Shore LS; Amer Chem Soc, ACS Symp Ser 791: 206-228 (2001) ]**PEER REVIEWED**

SURFACE WATER: A US Geological Survey measured 95 organic waste contaminants in water samples from 139 streams across 30 states during 1999 and 2000(1). Testosterone was detected in 2.8% of the 70 samples studied with a median concentration of 0.116 ug/L(1). Testosterone was detected at a concentration range of 0.031 to 0.069 nmol/L in Lake Kinneret, Israel, sampled from 1991-1992(2). [(1) Kolpin DW et al; Environ Sci Technol 36: 1202-11 (2002) (2) Shore LS et al Bull Environ Contam Toxicol 51: 361-366 (1993) ]**PEER REVIEWED**

EFFLUENT CONCENTRATIONS:
Testosterone was detected in constructed water treatment plant effluents in Maryland in concentrations of 2.1 and 1.6 ng/L for wetland effluent and peat effluent, respectively(1). Testosterone was detected in raw sewage effluent water sampled in Tel Aviv, Israel in 1991 at concentrations ranging from 208-320 ng/L (third year of a drought); lower concentrations were measured in 1992 after the drought was over(2). The testosterone level in secondary effluent from a Tel Aviv, Israel treatment plant was 50 ng/L(2). [(1) Drewes JE, Shore LS; Amer Chem Soc, ACS Symp Ser 791: 206-228 (2001) (2) Shore LS et al; Bull Environ Contam Toxicol 51: 361-6 (1993) ]**PEER REVIEWED**

OTHER ENVIRONMENTAL CONCENTRATIONS:
Testosterone has been detected in the manures of immature broilers, laying hens, and roosters at concentrations of 133, 254, and 670 ng/g dry weight, respectively(1). [(1) Drewes JE, Shore LS; Amer Chem Soc, ACS Symp Ser 791: 206-228 (2001) ]**PEER REVIEWED**

ENVIRONMENTAL STANDARDS & REGULATIONS:

FDA REQUIREMENTS:
The Approved Drug Products with Therapeutic Equivalence Evaluations List identifies currently marketed prescription drug products, incl testosterone, approved on the basis of safety and effectiveness by FDA under sections 505 of the Federal Food, Drug, and Cosmetic Act. [DHHS/FDA; Electronic Orange Book-Approved Drug Products with Therapeutic Equivalence Evaluations. Available from: http://www.fda.gov/cder/ob/ as of June 1, 2005 ]**PEER REVIEWED**

Schedules of controlled substances are established by section 202 of the Controlled Substances Act (21 U.S.C. 812). Schedule III shall consist of the drugs and other substances, by whatever official name, common or usual name, chemical name, or brand name designated, listed in this section. Unless specifically excepted or unless listed in another schedule, any material, compound, mixture, or preparation containing any quantity of the following substances, including its salts, isomers, and salts of isomers whenever the existence of such salts of isomers is possible within the specific chemical designation. DEA Code #: 4000; Drug class: anabolic steroids. [21 CFR 1308.13(f); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from: http://www.gpoaccess.gov/ecfr as of June 1, 2005 ]**PEER REVIEWED**

Implantation or injectable dosage form new animal drugs. Estradiol benzoate and testosterone propionate. ... Conditions of use: For implantation in heifers ... Indications for use: For increased rate of weight gain and improved feed efficiency. Limitations: For heifers weighing 400 pounds or more; for subcutaneous ear implantation, one dose per animal; not for use in dairy or beef replacement heifers. Safety and effectiveness have not been established in veal calves. A withdrawal period has not been established for this product in preruminating calves. Do not use in calves to be processed for veal. /Testosterone propionate/ [21 CFR 522.842; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from:

http://www.gpoaccess.gov/ecfr as of June 1, 2005 ]**PEER REVIEWED**

Tolerances for residues of new animal drugs in food. Testosterone propionate. No residues of testosterone, resulting from the use of testosterone propionate, are permitted in excess of the following increments above the concentrations of testosterone naturally present in untreated animals:(a) In uncooked edible tissues of heifers: (1) 0.64 part per billion in muscle. (2) 2.6 parts per billion in fat. (3) 1.9 parts per billion in kidney. (4) 1.3 parts per billion in liver. [21 CFR 556.710; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from: http://www.gpoaccess.gov/ecfr as of June 1, 2005 ]**PEER REVIEWED**

CHEMICAL/PHYSICAL PROPERTIES:

MOLECULAR FORMULA:

C19-H28-O2 [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

MOLECULAR WEIGHT:

288.42 [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

COLOR/FORM:

White needles from dil acetone [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21: 520 (1978)]**PEER REVIEWED**

White or cream white crystalline powder [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1081]**PEER REVIEWED**

Crystals [Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 10th ed. Volumes 1-3 New York, NY: John Wiley & Sons Inc., 1999., p. 3364]**PEER REVIEWED**

ODOR:

Odorless [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1081]**PEER REVIEWED**

MELTING POINT:

155 deg C [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

OCTANOL/WATER PARTITION COEFFICIENT:

log Kow = 3.32 [Hansch, C., Leo, A., D. Hoekman. Exploring QSAR - Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society., 1995., p. 164]**PEER REVIEWED**

SOLUBILITIES:

In ethanol: 1 in 5; in chloroform: 1 in 2; in diethyl ether: 1 in 100; in ethyl oleate: 1 in 150. Sol in acetone, dioxane and fixed oils [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21: 520 (1979)]**PEER REVIEWED**

Sol in vegetable oils [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1081]**PEER REVIEWED**

In water, 23.4 mg/L at 25 deg C [Yalkowsky, S.H., He, Yan., Handbook of Aqueous Solubility Data: An Extensive Compilation of Aqueous Solubility Data for Organic Compounds Extracted from the AQUASOL dATAbASE. CRC Press LLC, Boca Raton, FL. 2003., p. 1141]**PEER REVIEWED**

SPECTRAL PROPERTIES:

Specific optical rotation: +109 deg at 24 deg C/D (concentration by volume = 4 g in 100 ml alcohol) [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

Max absorption: 238 nm [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

SADTLER REFERENCE NUMBER: 727 (IR, PRISM); 13203 (IR, PRISM), 3128 (NMR) [Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979., p. C-511]**PEER REVIEWED**

IR: 5450 (Coblentz Society Spectral Collection) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V1: 238]**PEER REVIEWED**

UV: 7-851 (Organic Electronic Spectral Data, Phillips et al, John Wiley & Sons, New York) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V1: 238]**PEER REVIEWED**

NMR: 11900 (Sadtler Research Laboratories Spectral Collection) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V1: 238]**PEER REVIEWED**

13C NMR: 483 FT (Johnson and Jankowski, Carbon 13 NMR Spectra, John Wiley and Sons, NY) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V1: 238]**PEER REVIEWED**

MASS: 62026 (NIST/EPA/MSDC Mass Spectral Data Base, 1990 Version) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V1: 238]**PEER REVIEWED**

Intense mass spectral peaks: 124 m/z, 246 m/z, 288 m/z [Pfleger, K., H. Maurer and A. Weber. Mass Spectral and GC Data of Drugs, Poisons and their Metabolites. Parts I and II. Mass Spectra Indexes. Weinheim, Federal Republic of Germany. 1985., p. 499]**PEER REVIEWED**

VAPOR PRESSURE:

1.7X10-8 mm Hg at 25 deg C (est) [US EPA; Estimation Programs Interface (EPI). ver. 3.11. U.S. EPA version for Windows. Washington, DC: U.S. EPA (2003). Available at http://www.epa.gov/opptintr/exposure/docs/episuite.htm as of Apr 19, 2005. ]**PEER REVIEWED**

OTHER CHEMICAL/PHYSICAL PROPERTIES:

Dextrorotatory in dioxane solution [Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 14th Edition. John Wiley & Sons, Inc. New York, NY

2001., p. 1077]**PEER REVIEWED**

Mp: 140-141 deg C /Testosterone acetate/ [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

Crystals from methanolacetone; mp: 250-255 deg C (decomposition); specific optical rotation: +73 deg at 19 deg C/D (concentration by volume = 0.992 g in 100 ml methanol); freely sol in water /Testosterone beta-maltoside/ [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

WHITE OR CREAMY WHITE CRYSTALS OR CRYSTALLINE POWDER. ODORLESS OR HAS SLIGHT ODOR. PRACTICALLY INSOL IN WATER; FREELY SOL IN ALC, CHLOROFORM, DIOXANE, ETHER /CYPIONATE/ [Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975., p. 933]**PEER REVIEWED**

Specific optical rotation: +87 deg at 25 deg C/D (CHCl3); mp: 101-102 deg C. Soluble in oils. /17beta-Cyclopentaneproprionate/ [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

WHITE OR CREAMY WHITE CRYSTALS OR CRYSTALLINE POWDER. ODORLESS OR HAS FAINT ODOR CHARACTERISTIC OF ENANTHIC ACID. PRACTICALLY INSOL IN WATER. 1 G IN ABOUT 0.3 ML ETHER. SOL IN VEGETABLE OILS /ENANTHATE/ [Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975., p. 933]**PEER REVIEWED**

Crystals. Mp: 36-37.5 deg C /Enanthate/ [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

SOL IN CHLOROFORM /ENANTHATE/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21: 522 (1978)]**PEER REVIEWED**

WHITE OR CREAMY WHITE CRYSTALS OR CRYSTALLINE POWDER. ODORLESS. PRACTICALLY INSOL IN WATER; SOL IN VEGETABLE OILS. FREELY SOL IN ALC, DIOXANE, ETHER; FREELY SOL IN ORG SOLVENTS /PROPIONATE/ [Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975., p. 933]**PEER REVIEWED**

Stout prisms from alcohol and water, mp 118-122 deg C. Specific optical rotation = +83.0 to 90 deg at 25 C/D (100 mg in 10 ml dioxane). Freely soluble in pyridine and other organic solvents. /Propionate/ [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

Henry's Law constant = 3.5X10-9 atm-cu m/mole at 25 deg C (est) [US EPA; Estimation Programs Interface (EPI). ver. 3.11. U.S. EPA version for Windows. Washington, DC: U.S. EPA (2003). Available at http://www.epa.gov/opptintr/exposure/docs/episuite.htm as of Apr 19, 2005. ]**PEER REVIEWED**

Hydroxyl radical reaction rate constant = 1.1X10-10 cu cm/molec-sec at 25 deg C (est) [US EPA; Estimation Programs Interface (EPI). ver. 3.11. U.S. EPA version for Windows. Washington, DC: U.S. EPA (2003). Available at

http://www.epa.gov/opptintr/exposure/docs/episuite.htm as of Apr 19, 2005. ]**PEER REVIEWED**

Ozone radical reaction rate constant = 1.1X10-17 cu cm/molec-sec at 25 deg C (est) [US EPA; Estimation Programs Interface (EPI). ver. 3.11. U.S. EPA version for Windows. Washington, DC: U.S. EPA (2003). Available at http://www.epa.gov/opptintr/exposure/docs/episuite.htm as of Apr 19, 2005. ]**PEER REVIEWED**

CHEMICAL SAFETY & HANDLING:

HAZARDOUS DECOMPOSITION:

When heated to decomposition it emits acrid smoke and fumes. [Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984., p. 2512]**PEER REVIEWED**

STABILITY/SHELF LIFE:

Easily oxidized [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 520 (1979)]**PEER REVIEWED**

Stable in air /testosterone, cypionate, propionate/ [Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975., p. 933]**PEER REVIEWED**

STORAGE CONDITIONS:

Commercially available testosterone preparations should be stored at a temperature less than 40 deg C, preferably between 15-30 deg C; freezing of the sterile suspension and injections should be avoided. A precipitate may form if the injections are stored at a low temperature; however, this will dissolve after shaking and warming to room temperature. Use of a wet needle or syringe may cause the parenteral solutions to become cloudy; however, this will not affect potency. [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2955]**PEER REVIEWED**

DISPOSAL METHODS:

SRP: The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational exposure or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations. [ ]**PEER REVIEWED**

OCCUPATIONAL EXPOSURE STANDARDS:

MANUFACTURING/USE INFORMATION:

MAJOR USES:

Biochemical research [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993, p. 1125]**PEER REVIEWED**

MEDICATION (VET) **PEER REVIEWED**

MEDICATION **PEER REVIEWED**

MANUFACTURERS:

Auxilium Pharmaceuticals, Inc., 160 West Germantown Pike, Norristown, PA 19401, 610-239-1499 [PDR; Physicians' Desk Reference. 52nd ed. Montvale, NJ: Medical Economics Co. p. 673 (2005) ]**PEER REVIEWED**

Columbia Laboratories, Inc., 354 Eisenhower Pkwy., Second Floor -Plaza 1, Livingston, NJ 07039, 973-994-3999 [PDR; Physicians' Desk Reference. 52nd ed. Montvale, NJ: Medical Economics Co. p. 1150 (2005) ]**PEER REVIEWED**

Unimed Pharmaceuticals, Inc., 901 Sawyer Rd., Marietta, GA 30062, 770-578-9000 [PDR; Physicians' Desk Reference. 52nd ed. Montvale, NJ: Medical Economics Co. p. 3244 (2005) ]**PEER REVIEWED**

Savient Parmaceuticals, Inc., One Tower Center, Fouteenth floor East Brunswick, NJ 08816, 800-741-2696 /Testosterone cypionate/ [PDR; Physicians' Desk Reference. 52nd ed 2005. Montvale,NJ: Medical Economics Co. p. 3018 (2005) ]**PEER REVIEWED**

Watson Laboratories, Inc., 311 Bonnie Circle, Corona, CA 92880, 800-272-5525 /Testosterone cypionate; testosterone enanthate/ [PDR; Physicians' Desk Reference. 52nd ed. Montvale, NJ: Medical Economics Co. p. 3296 (2005) ]**PEER REVIEWED**

METHODS OF MANUFACTURING:

PREPD BY CONVERSION OF OTHER STEROIDS SUCH AS CHOLESTEROL. THE IMPORTANT INTERMEDIATE DEHYDROANDROSTERONE IS EFFICIENTLY TRANSFORMED INTO TESTOSTERONE BY MICROBIAL PROCESS. [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

Isolation from extract of testis, synthesis ... from the plant steroid. [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993, p. 1125]**PEER REVIEWED**

Testosterone is synthesized from androstenolone acetate which is reduced to the 17beta-alcohol with Raney nickel and then esterified with benzoyl chloride in pyridine. This protecting ester group permits partial saponification of the 3-acetate with methanolic sodium hydroxide solution to yield the 3-hydroxy compound. Subsequent Oppenauer oxidation produces the testosterone benzoate, which is then subjected to alkaline hydrolysis to give testosterone. [Ullmann's Encyclopedia of  Industrial Chemistry. 6th ed.Vol 1: Federal Republic of Germany: Wiley-VCH Verlag GmbH & Co. 2003 to Present, p. V16 627 (2003)]**PEER REVIEWED**

GENERAL MANUFACTURING INFORMATION:

The literature suggests that some pharmaceutically active compounds originating from human and veterinary therapy are not eliminated completely in municipal sewage treatment plants and are therefore discharged into receiving waters(1). Wastewater treatment processes often were not designed to remove them from the effluent(2). Selected organic waste compounds may be degrading to new and more persistent compounds that may be released instead of or in addition to the parent compound(2). [(1) Heberer T; Tox Lett 131: 5-17 (2002) (2) Koplin DW et al; Environ Sci Toxicol 36: 1202-211 (2002) ]**PEER REVIEWED**

US REGULATIONS ESTABLISH 0 TOLERANCE FOR RESIDUES OF DRUG IN EDIBLE TISSUE & BY-PRODUCTS FROM HEIFERS. LEGAL CLARIFICATION ... NEEDED ON RESIDUES IN OTHER ANIMALS. [Rossoff, I.S. Handbook of Veterinary Drugs. New York: Springer Publishing Company, 1974., p. 585]**PEER REVIEWED**

An androgenic steroid; the male sex hormone produced by the testis. It has

six times the androgenic activity of its metabolic product, androsterone. [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993, p. 1125]**PEER REVIEWED**

Principal hormone of the testes, produced by the interstitial cells. [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

Anabolic Steroid Control Act of 2004. Public Law 108-358 (October 22, 2004)... includes /testosterone/ as an anabolic steroid [US Gov Print Off; National Archives and Records Administration. Catalog of Public and Private Laws - 108th Congress. Pub.L. 108-358. Available from the database query page at http://www.access.gpo.gov/nara/publaw/108publ.html as of Jun 2, 2005. ]**PEER REVIEWED**

FORMULATIONS/PREPARATIONS:

Parenteral: Injection (in oil): 100 mg/mL (C-III), (available by nonproprietary name). /Testosterone propionate/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Parenteral: Injection (in oil): 200 mg/mL Delatestryl (C-III; with chlorobutanol; available as Unimatic disposable syringes and multiple-dose vials), (BTG). /Testosterone enanthate/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Parenteral: Injection (in oil): 100 mg/mL Depo-Testosterone (C-III with benzyl alcohol), (Pfizer); 200 mg/mL Depo-Testosterone (C-III; with benzyl alcohol), (Pfizer), Virilon IM (C-III; with benzyl alcohol), (Star). /Testosterone cypionate/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Topical: Transdermal System: 2.5 mg/24 hour (12.2 mg/37 sq cm) Androderm (C-III; with alcohol), (Watson); 4 mg/24 hour (10 mg/40 sq cm) Testoderm (C-III; available with or without adhesive), (Ortho-McNeil); 5 mg/24 hour (24.3 mg/44 sq cm) Androderm (C-III; with alcohol), (Watson); 5 mg/24 hour (328 mg/60 sq cm) Testoderm TTS (C-III; with 1.2 mL alcohol), (Ortho-McNei);l 6 mg/24 hour (15 mg/60 sq cm) Testoderm (C-III; available with or without adhesive), (Ortho-McNeil). [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Topical: Gel: 1% (25 and 50 mg) AndroGel (C-III; with alcohol 68.9%), (Unimed); 1% (50 mg) Testim (C-III; with alcohol 74%), (Auxilium) [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

TESTOSTERONE (TESTOJECT-50) AQUEOUS SUSPENSION FOR IM USE: 10-50 MG; TESTOSTERONE PROPIONATE (TESTEX) OILY SOLN FOR IM USE : 10 TO 25 MG; TESTOSTERONE ENANTHATE (DELATESTRYL) OILY SOLN FOR IM USE: 50-400 MG. [Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY. Pergamon Press, 1990., p. 1421]**PEER REVIEWED**

TESTOSTERONE CYPIONATE (DEPO-TESTOSTERONE): OILY SOLN FOR IM USE: 50-400 MG; NANDROLONE DECANOATE (DECA-DURABOLIN) OILY SOLN FOR IM USE: 50-100 MG;

NANDROLONE PHENPROPIONATE (DURABOLIN) OILY SOLN FOR IM USE: 50-100 MG [Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY. Pergamon Press, 1990., p. 1421]**PEER REVIEWED**

Grade: National Formulary [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993, p. 1125]**PEER REVIEWED**

Parenteral: Implants, for subcutaneous use: 75 mg Testopel Pellets (C-III; with povidone), (Bartor); Injectable suspension: 100 mg/mL (C-III) (available by nonproprietary name). [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

0.015 MG= 1 INTERNATIONAL UNIT [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

LABORATORY METHODS:

CLINICAL LABORATORY METHODS:

Sample matrix: Bulk chemical. Sample preparation: Dissolve (ethanol). Assay procedure: UV at 240 nm. Limit of detection: 1.25 ug/ml. /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 526 (1979)]**PEER REVIEWED**

Sample matrix: Plasma. Sample preparation: Derivatize (heptafluorobutyrate); TLC. Assay procedure: GC/ECD. Limit of detection: 10 pg. /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 526 (1979)]**PEER REVIEWED**

Sample matrix: Urine. Sample preparation: TLC; oxidize [chromium (III)oxide]; derivatize (2,4-dinitrophenylhydrazone); TLC. Assay procedure: Colorimetry. Limit of detection: 0.5 ug. /From table/[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 529 (1979)]**PEER REVIEWED**

Sample matrix: Plasma. Sample preparation: Extract (diethyl ether); derivatize (heptafluorobutyrate). Assay procedure: GC/MS. Limit of detection: 0.21 ng/ml. /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 529 (1979)]**PEER REVIEWED**

Sample matrix: Plasma. Sample preparation: Extract (dichloromethane); wash (sodium hydroxide); column chromatography (silica gel). Assay procedure: Fluorimetry. Limit of detection: 10 ng (5 ml sample). /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 528 (1979)]**PEER REVIEWED**

Sample matrix: Ovarian tissue. Sample preparation: Homogenize (sodium hydroxide); extract (diethyl ether-ethyl acetate-ethanol); wash (sodium

hydroxide). Assay procedure: Gas chromatography/flame ionization detection. Limit of detection: 25 ng. /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 530 (1979)]**PEER REVIEWED**

Sample matrix: Prostate tissue. Sample preparation: Add labelled testosterone; adsorb (silica gel); wash (hexane; elute (ethyl acetate); TLC; add antiserum. Assay procedure: RIA. Limit of detection: 10 pg. /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 530 (1979)]**PEER REVIEWED**

Sample matrix: Breast tumour tissue. Sample preparation: Homogenize (acetone); decant; evaporate; dissolve (80% aqueous methanol); wash (petroleum ether); evaporate dissolve (diethyl ether); wash (water); evaporate; derivatize (trimethylsilyl). Assay procedure: GC/MS. Limit of detection: 30 pg (1 ul sample). /From table/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 530 (1979)]**PEER REVIEWED**

Integrated methodological approach to the GC/MS analysis of anabolic steroid metabolites in urine. The analytical approach developed for GC/MS screening of anabolic steroids is based on the sequential selection-ion monitoring of specific and discrete ion groups characteristic to the steroids of interest under high resolutionn chromatographic conditions. [Masse R et al; J Chromatogr 489 (1): 23-50 (1989)]**PEER REVIEWED**

An isocratic high-performance liquid chromatographic method for the determination of testosterone in human urine using liquid-liquid or solid-phase extraction (SPE) with a UV-absorbance detection at 245 nm. [Gonzalo-Lumbreras R et al; J Chromatogr Sci. 2003 May-Jun;41(5):261-5 (2003) ]**PEER REVIEWED** <a href="http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&dopt=Abstract&list_uids=12841955&query_hl=93" target=new>PubMed Abstract

ANALYTIC LABORATORY METHODS:

Analyte: testosterone; matrix: chemical identification; procedure: infrared absorption spectrophotometry with comparison to standards [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1875 (2005) ]**PEER REVIEWED**

Analyte: testosterone; matrix: chemical identification; procedure: ultraviolet absorption spectrophotometry with comparison to standards [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1875 (2005) ]**PEER REVIEWED**

Analyte: testosterone; matrix: chemical purity; procedure: single-steroid assay [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1875 (2005) ]**PEER REVIEWED**

Analyte: testosterone; matrix: pharmaceutical preparation (injectable suspension); procedure: infrared absorption spectrophotometry with comparison to standards (chemical identification) [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1876 (2005) ]**PEER REVIEWED**

Analyte: testosterone; matrix: pharmaceutical preparation (injectable suspension); procedure: ultraviolet absorption spectrophotometry with comparison to standards (chemical identification) [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1876 (2005) ]**PEER REVIEWED**

Analyte: testosterone cypionate; matrix: chemical identification; procedure: infrared absorption spectrophotometry with comparison to standards /Testosterone cypionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1876 (2005) ]**PEER REVIEWED**

Analyte: testosterone cypionate; matrix: chemical purity; procedure: gas chromatography with flame-ionization detection and comparison to standards /Testosterone cypionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1876 (2005) ]**PEER REVIEWED**

Analyte: testosterone cypionate; matrix: pharmaceutical preparation (injection); procedure: thin-layer chromatography with comparison to standards (chemical identification) /Testosterone cypionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1876 (2005) ]**PEER REVIEWED**

Analyte: testosterone cypionate; matrix: pharmaceutical preparation (injection); procedure: gas chromatography with flame-ionization detection with comparison to standards (chemical purity) /Testosterone cypionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1877 (2005) ]**PEER REVIEWED**

Analyte: testosterone enanthate; matrix: chemical identification; procedure: infrared absorption spectrophotometry with comparison to standards /Testosterone enanthate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1877 (2005) ]**PEER REVIEWED**

Analyte: testosterone enanthate; matrix: chemical identification; procedure: ultraviolet absorption spectrophotometry with comparison to standards /Testosterone enanthate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1877 (2005) ]**PEER REVIEWED**

Analyte: testosterone enanthate; matrix: pharmaceutical preparation (injection); procedure: thin-layer chromatography with comparison to standards (chemical identification) /Testosterone enanthate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1877 (2005) ]**PEER REVIEWED**

Analyte: testosterone propionate; matrix: chemical identification; procedure: infrared absorption spectrophotometry with comparison to standards /Testosterone propionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1878 (2005) ]**PEER REVIEWED**

Analyte: testosterone propionate; matrix: chemical identification; procedure: ultraviolet absorption spectrophotometry with comparison to standards /Testosterone propionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1878 (2005) ]**PEER REVIEWED**

Analyte: testosterone propionate; matrix: pharmaceutical preparation (injection); procedure: thin layer chromatography with comparison to standards (chemical identification) /Testosterone propionate/ [U.S. Pharmacopeia. The United States Pharmacopeia, USP 28/The National Formulary, NF 23; Rockville, MD: U.S. Pharmacopeial Convention, Inc., p1878 (2005) ]**PEER REVIEWED**

SPECIAL REFERENCES:

SYNONYMS AND IDENTIFIERS:

SYNONYMS:

Andro [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

Androderm [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

ANDROLIN [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

ANDRONAQ [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

Andropatch [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

ANDROST-4-EN-17BETA-OL-3-ONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

delta4-Androsten-17beta-ol-3-one [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

ANDROST-4-EN-3-ONE, 17-BETA-HYDROXY- [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

ANDRUSOL [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

CRISTERONA T **PEER REVIEWED**

GENO-CRISTAUX GREMY [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

HOMOSTERON [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

HOMOSTERONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

17beta-Hydroxyandrost-4-ene-3-one [Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985., p. 835]**PEER REVIEWED**

17-BETA-HYDROXYANDROST-4-EN-3-ONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

17-HYDROXY-(17-BETA)-ANDROST-4-EN-3-ONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

(17beta)-17-Hydroxyandrost-4-en-3-one [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

17-BETA-HYDROXY-DELTA(SUP 4)-ANDROSTEN-3-ONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

Malestrone (amps) [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

MERTESTATE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

NEOTESTIS [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V21 519 (1979)]**PEER REVIEWED**

Oreton [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

ORQUISTERON [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

PERANDREN **PEER REVIEWED**

PERCUTACRINE ANDROGENIQUE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

PRIMOTEST [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

PRIMOTESTON [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

DELTA(SUP 4)-ANDROSTEN-17(BETA)-OL-3-ONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

SUSTANON [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

SUSTANONE **PEER REVIEWED**

TESLEN [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTANDRONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

Testex [Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY. Pergamon Press, 1990., p. 1421]**PEER REVIEWED**

TESTICULOSTERONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTOBASE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical

Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

Testoderm [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

Testoject-50 [Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY. Pergamon Press, 1990., p. 1421]**PEER REVIEWED**

Testolin [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

TESTOPROPON **PEER REVIEWED**

TESTOSTEROID [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTOSTERON **PEER REVIEWED**

TRANS-TESTOSTERONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTOSTERONE HYDRATE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTOSTOSTERONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTOVIRON SCHERING [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

Testro AQ [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 1638]**PEER REVIEWED**

TESTRONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

TESTRYL [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

VIRORMONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

VIROSTERONE [U.S. Department of Health, Education & Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety & Health. Registry of Toxic Effects of Chemical Substances. 1978 edition. Washington, DC: U.S. Government Printing Office, 1979., p. 1196]**PEER REVIEWED**

FORMULATIONS/PREPARATIONS:

Parenteral: Injection (in oil): 100 mg/mL (C-III), (available by nonproprietary name). /Testosterone propionate/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Parenteral: Injection (in oil): 200 mg/mL Delatestryl (C-III; with chlorobutanol; available as Unimatic disposable syringes and multiple-dose vials), (BTG). /Testosterone enanthate/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Parenteral: Injection (in oil): 100 mg/mL Depo-Testosterone (C-III with benzyl alcohol), (Pfizer); 200 mg/mL Depo-Testosterone (C-III; with benzyl alcohol), (Pfizer), Virilon IM (C-III; with benzyl alcohol), (Star). /Testosterone cypionate/ [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Topical: Transdermal System: 2.5 mg/24 hour (12.2 mg/37 sq cm) Androderm (C-III; with alcohol), (Watson); 4 mg/24 hour (10 mg/40 sq cm) Testoderm (C-III; available with or without adhesive), (Ortho-McNeil); 5 mg/24 hour (24.3 mg/44 sq cm) Androderm (C-III; with alcohol), (Watson); 5 mg/24 hour (328 mg/60 sq cm) Testoderm TTS (C-III; with 1.2 mL alcohol), (Ortho-McNei);l 6 mg/24 hour (15 mg/60 sq cm) Testoderm (C-III; available with or without adhesive), (Ortho-McNeil). [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

Topical: Gel: 1% (25 and 50 mg) AndroGel (C-III; with alcohol 68.9%), (Unimed); 1% (50 mg) Testim (C-III; with alcohol 74%), (Auxilium) [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

TESTOSTERONE (TESTOJECT-50) AQUEOUS SUSPENSION FOR IM USE: 10-50 MG; TESTOSTERONE PROPIONATE (TESTEX) OILY SOLN FOR IM USE : 10 TO 25 MG; TESTOSTERONE ENANTHATE (DELATESTRYL) OILY SOLN FOR IM USE: 50-400 MG. [Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY. Pergamon Press, 1990., p. 1421]**PEER REVIEWED**

TESTOSTERONE CYPIONATE (DEPO-TESTOSTERONE): OILY SOLN FOR IM USE: 50-400 MG; NANDROLONE DECANOATE (DECA-DURABOLIN) OILY SOLN FOR IM USE: 50-100 MG; NANDROLONE PHENPROPIONATE (DURABOLIN) OILY SOLN FOR IM USE: 50-100 MG [Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY.

Pergamon Press, 1990., p. 1421]**PEER REVIEWED**

Grade: National Formulary [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993, p. 1125]**PEER REVIEWED**

Parenteral: Implants, for subcutaneous use: 75 mg Testopel Pellets (C-III; with povidone), (Bartor); Injectable suspension: 100 mg/mL (C-III) (available by nonproprietary name). [McEvoy, G.K. (ed.). American Hospital Formulary Service- Drug Information 2005. Bethesda, MD: American Society of Health-System Pharmacists, Inc. 2005 (Plus Supplements)., p. 2956]**PEER REVIEWED**

0.015 MG= 1 INTERNATIONAL UNIT [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1446]**PEER REVIEWED**

ADMINISTRATIVE INFORMATION:

HAZARDOUS SUBSTANCES DATABANK NUMBER: 3398

LAST REVISION DATE: 20060414

LAST REVIEW DATE: Reviewed by SRP on 9/15/2005

UPDATE HISTORY:

Complete Update on 2006-04-14, 46 fields added/edited/deleted

Complete Update on 08/06/2002, 1 field added/edited/deleted.

Complete Update on 01/14/2002, 1 field added/edited/deleted.

Complete Update on 02/02/2000, 1 field added/edited/deleted.

Complete Update on 09/21/1999, 1 field added/edited/deleted.

Complete Update on 08/27/1999, 1 field added/edited/deleted.

Complete Update on 10/29/1998, 1 field added/edited/deleted.

Complete Update on 06/02/1998, 1 field added/edited/deleted.

Complete Update on 03/11/1998, 5 fields added/edited/deleted.

Field Update on 10/26/1997, 1 field added/edited/deleted.

Field Update on 05/01/1997, 2 fields added/edited/deleted.

Complete Update on 01/26/1996, 1 field added/edited/deleted.

Complete Update on 12/30/1994, 1 field added/edited/deleted.

Complete Update on 05/12/1994, 37 fields added/edited/deleted.

Field Update on 11/01/1993, 1 field added/edited/deleted.

Field update on 12/30/1992, 1 field added/edited/deleted.

Complete Update on 10/22/1990, 2 fields added/edited/deleted.

Complete Update on 04/16/1990, 1 field added/edited/deleted.

Field update on 12/29/1989, 1 field added/edited/deleted.

Complete Update on 01/11/1985

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