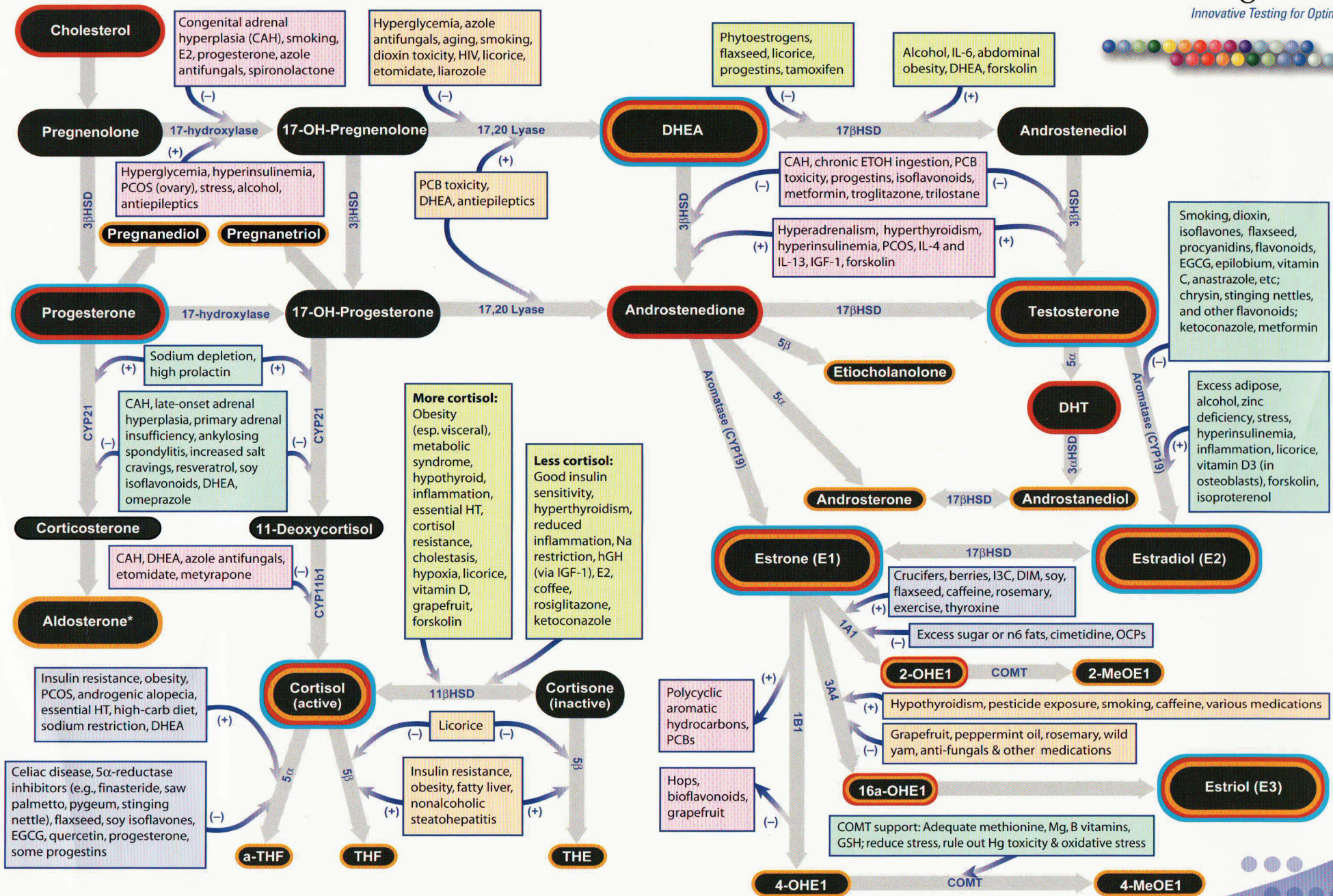


# Steroidogenic Pathways



Hormones measurable by Genova Diagnostics:

- Measurable in Urine
- Measurable in Blood
- Measurable in Saliva

# References

## 3 $\beta$ HSD (3beta-hydroxysteroid dehydrogenase)

### Lower activity:

- Alcohol: Chiao YB, et al. Alcohol Clin Exp Res. 1981 Spring;5(2):230-6.
- PCBs: Andric SA, et al. Environ Health Perspect. 2000 Oct;108(10):955-9
- Proggestins: Lee TC, et al. J Clin Endocrinol Metab. 1999 Jun;84(6):2104-10.
- Isoflavonoids: Deluca D, et al. J Steroid Biochem Mol Biol. 2005 Feb;93(2-5):285-92.

### Higher activity:

- Hyperadrenalism: Simonian MH. J Steroid Biochem. 1986 Dec;25(6):1001-6.
- Hyperinsulinemia: DeClue TJ, et al. J Clin Endocrinol Metab. 1991 Jun;72(6):1308-11.
- PCOS: Strauss JF 3rd. Ann N Y Acad Sci. 2003 Nov;997:42-8.
- Forskolin: Bird IM, et al. J Endocrinol. 1996 Sep;150 Suppl:S165-73.

## 5 $\alpha$ (5alpha-reductase)

### Lower activity:

- Flaxseed, isoflavones: Evans BA, et al. J Endocrinol. 1995 Nov;147(2):295-302.
- EGCG: Hiiipakka RA, et al. Biochem Pharmacol. 2002 Mar 15;63(6):1165-76.
- Progesterone: Cassidenti DL, et al. Obstet Gynecol. 1991 Jul;78(1):103-7.
- Saw palmetto: Drsata J, et al. Cas Lek Cesk. 2002 Oct 11;141(20):630-5.

### Higher activity:

- Insulin resistance, obesity: Westerbacka J, et al. J Clin Endocrinol Metab. 2003 Oct;88(10):4924-31.
- Essential HT: Soro A, et al. Hypertension. 1995 Jan;25(1):67-70.
- DHEA: Stomati M, et al. Gynecol Endocrinol. 2000 Oct;14(5):342-63.

## 5 $\beta$ (5beta-reductase)

### Lower activity:

- Licorice: Tamura Y, et al. Arzneimittelforschung. 1979;29(4):647-9.

### Higher activity:

- Insulin resistance, fatty liver: Westerbacka J, et al. J Clin Endocrinol Metab. 2003 Oct;88(10):4924-31.

## CYP11 $\beta$ 1 (11beta-hydroxylase)

### Lower activity:

- Azole antifungals: Ayub M, et al. J Steroid Biochem. 1989 Apr;32(4):515-24.
- DHEA: Stomati M, et al. Gynecol Endocrinol. 2000 Oct;14(5):342-63.

## 11 $\beta$ HSD (11beta-hydroxysteroid dehydrogenase)

### More cortisol:

- Metabolic syndrome: Seckle JR, et al. Recent Prog Horm Res. 2004;59:359-93.
- Inflammation: Cai TQ, et al. J Steroid Biochem Mol Biol. 2001 May;77(2-3):117-22.
- Hypothyroid: Hoshiro M, et al. Clin Endocrinol (Oxf). 2006 Jan;64(1):37-45.
- Licorice: Ferrari P, et al. Hypertension. 2001 Dec 1;38(6):1330-6.

### Less cortisol:

- Hyperthyroidism: Taniyama M, et al. Thyroid. 1993 Fall;3(3):229-33.
- Coffee: Atanasov AG, et al. FEBS Lett. 2006 Jul 24;580(17):4081-5. Epub 2006 Jun 27
- Ketoconazole: Stiefel P, et al. Endocrine. 2002 Aug;18(3):279-84.
- Rosiglitazone: Berthiaume M, et al. Am J Physiol Regul Integr Comp Physiol. 2004 Nov;287(5):R1116-23.

## 17 $\alpha$ -hydroxylase

### Lower activity:

- Smoking: Yeh J, et al. J Steroid Biochem. 1989 Oct;33(4A):627-30.
- Antifungals: Weber MM, et al. Clin Investig. 1993 Nov;71(11):933-8.
- Spironolactone: Kossor DC, et al. Mol Pharmacol. 1991 Aug;40(2):321-5.

### Higher activity:

- Hyperglycemia: Ueshiba H, et al. Eur J Endocrinol. 2002 Mar;146(3):375-80.
- Hyperinsulinemia: Nestler JE, et al. N Engl J Med. 1996 Aug 29;335(9):617-23.
- Stress: Sirianni R, et al. J Clin Endocrinol Metab. 2005 Jan;90(1):279-85. Epub 2004 Oct 19.
- Alcohol: Chiao YB, et al. Alcohol Clin Exp Res. 1981 Spring;5(2):230-6.

## 17,20 lyase

### Lower activity:

- Hyperglycemia: Ueshiba H, et al. Eur J Endocrinol. 2002 Mar;146(3):375-80.
- Azole antifungals: Ayub M, Levell MJ. J Steroid Biochem. 1989 Apr;32(4):515-24.
- Dioxins: Moran FM, et al. Biol Reprod. 2003 Jan;68(1):244-51.
- Licorice: Deluca D, et al. J Steroid Biochem Mol Biol. 2005 Feb;93(2-5):285-92.

### Higher activity:

- PCBs: Andric SA, et al. Environ Health Perspect. 2000 Oct;108(10):955-9.
- DHEA: Stomati M, et al. Gynecol Endocrinol. 2000 Oct;14(5):342-63.
- Anti-epileptics (valproate): Nelson-DeGrave VL, et al. Endocrinology. 2004 Feb;145(2):799-808. Epub 2003 Oct 23.

## 17.HSD (17beta-hydroxysteroid dehydrogenase)

### Lower activity of 17 $\beta$ -HSD type 1 (e.g., resulting in less E2 or testosterone)

- Phytoestrogens: Krazeisen A, et al. Adv Exp Med Biol. 2002;505:151-61.
- Licorice: Armanini D, et al. N Engl J Med. 1999 Oct 7;341(15):1158.
- Pasqualini JR, Ebert C. Gynecol Endocrinol. 1999 Jun;13 Suppl 4:11-9.
- Tamoxifen: Speirs V, et al. J Steroid Biochem Mol Biol. 1993 Nov;46(5):605-11.

### Higher activity of 17.HSD type 1 (e.g., resulting in more E2 or testosterone)

- Alcohol: Sarkola T, et al. Alcohol Alcohol. 2000 Jan;35(1):84-90.
- Abdominal obesity: Corbould AM, et al. Int J Obes Relat Metab Disord. 2002 Feb;26(2):165-75.
- DHEA: Bonney RC, et al. J Steroid Biochem. 1983 Jan;18(1):59-64.

## CYP19 (Aromatase)

### Lower activity:

- Dioxins: Drenth HJ, et al. Toxicol Appl Pharmacol. 1998 Jan;148(1):50-5.
  - Phytoestrogens: Krazeisen A, et al. Mol Cell Endocrinol. 2001 Jan 22;171(1-2):151-62.
  - EGCG, green tea catechins: Kapiszewska M, et al. Br J Nutr. 2006 May;95(5):989-95.
  - Chrysin: Edmunds KM, et al. Reprod Nutr Dev. 2005 Nov-Dec;45(6):709-20.
- ### Higher activity:
- Inflammation: Cutolo M, et al. Ann N Y Acad Sci. 2006 Nov;1089:538-47.
  - Licorice: Takeuchi T, et al. Am J Chin Med. 1991;19(1):73-8.
  - Vitamin D3: Lou YR, et al. J Steroid Biochem Mol Biol. 2005 Feb;94(1-3):151-7. Epub 2005 Feb 17.

## CYP21 (21alpha-hydroxylase)

### Lower activity:

- Late-onset adrenal hyperplasia: Carmina E, et al. J Endocrinol Invest. 1984 Apr;7(2):89-92.
- Primary adrenal insufficiency: Nikfarjam L, et al. Eur J Endocrinol. 2005 Jan;152(1):95-101.
- Resveratrol: Supornsilchai V, et al. Horm Res. 2005;64(6):280-6. Epub 2005 Nov 1.
- DHEA: Stomati M, et al. Gynecol Endocrinol. 2000 Oct;14(5):342-63.

### Higher activity:

- Sodium depletion: Tremblay A, et al. J Biol Chem. 1991 Feb 5;266(4):2245-51.
- High prolactin: Kau MM, et al. J Cell Biochem. 1999 Feb 1;72(2):286-93.

## CYP1A1

### Lower activity:

- Excess sugar: Peters LP, Teel RW. Anticancer Res. 2003 Jan-Feb;23(1A):399-403.
- Excess omega 6 fats: Lord RS, et al. Altern Med Rev. 2002 Apr;7(2):112-29.
- Oral contraceptives: Jernstrom H, et al. Carcinogenesis. 2003 May;24(5):991-1005.
- Cimetidine: Galbraith RA, Michnovicz JJ. N Engl J Med. 1989 Aug 3;321(5):269-74.

### Higher activity:

- Strawberries, blackberries, raspberries: Sowers MR, et al. J Nutr. 2006 Jun;136(6):1588-95.
- Soy isoflavones: Lu LJ. Cancer Res. 2000 Mar 1;60(5):1299-305.
- Caffeine: Sowers MR, et al. J Nutr. 2006 Jun;136(6):1588-95.
- Thyroxine: Michnovicz JJ, Galbraith RA. Steroids. 1990 Jan;55(1):22-6.

## CYP1B1

### Lower activity:

- Hops: Henderson MC, et al. Xenobiotica. 2000 Mar;30(3):235-51.
  - Bioflavonoids: Doostdar H, et al. Toxicology. 2000 Apr 3;144(1-3):31-8.
  - Grapefruit: Girenavar B, et al. Bioorg Med Chem. 2006 Apr 15;14(8):2606-12.
- ### Higher activity:
- PAHs, PCBs: Carpenter DO, et al. Environ Health Perspect. 1998 Dec;106 Suppl 6:1263-70.

## CYP3A4

### Lower activity:

- Grapefruit: Fukuda K, et al. Pharmacogenetics. 1997 Oct;7(5):391-6.
  - Rosemary: Zhu BT, et al. Carcinogenesis. 1998 Oct;19(10):1821-7.
  - Wild yam: Wu WH, et al. J Am Coll Nutr. 2005 Aug;24(4):235-43.
  - Peppermint oil: Dresser GK, et al. Clin Pharmacol Ther. 2002 Sep;72(3):247-55.
- ### Higher activity:
- Hypothyroidism: Liddle C, et al. J Clin Endocrinol Metab. 1998 Jul;83(7):2411-6.
  - Pesticides: Bradlow HL, et al. Environ Health Perspect. 1995 Oct;103 Suppl 7:147-50.
  - Smoking or caffeine: Sowers MR, et al. J Nutr. 2006 Jun;136(6):1588-95.

## COMT—Methylation support

- Rule out Hg toxicity: Houston MC. Altern Ther Health Med. 2007 Mar-Apr;13(2):S128-33.
- Rule out oxidative stress: James SJ, et al. Am J Clin Nutr. 2004 Dec;80(6):1611-7.
- Reduce stress: Dubey RK, et al. J Clin Endocrinol Metab. 2004 Aug;89(8):3922-31.