POLYCYSTIC OVARIAN SYNDROME
& ITS RELATIONSHIP WITH
INSULIN RESISTANCE

Introduction:

The insulin resistance material in this home study unit has been brought to the attention of the electrology profession due to the research and dedication of Shelby Owens, CME. Author of "*About That Hair*", Mrs. Owens has been a pioneer in the field of electrology. She and Karen Snow, MD (the supervising physician of Mrs. Owens' laser hair removal clinic in Pensacola, FL), have worked passionately and diligently on the PCOS/insulin resistance relationship. Mrs. Owens and Dr. Snow have worked together to collect and derive some logical conclusions for the patterns of hair growth that electrologists routinely see in their hair removal clinics. Over the past few years of observation and study, they have discovered that the condition of insulin resistance is running rampant in our society today. Upon further study, we now realize that insulin resistance and Polycystic Ovarian Syndrome (PCOS) are vitally linked with each other.

Electrologists have been observing these patterns for decades, but not until the first few years of the 21st century, have we begun to understand their implications. With the addition of hair removal lasers in our arsenal, we can now to see completed treatments move faster and therefore observe hair removal outcomes and the patterns of their hair growth in a more accelerated venue.

Goals and Objectives:

The goal of this home study unit is to:

- Define Polycystic Ovarian Syndrome (PCOS)
- Define Insulin Resistance
- Disclose conditions and symptoms of PCOS.
- Disclose conditions and symptoms of insulin resistance
- Inform electrologists on how to identify symptoms of PCOS and insulin resistance so proper medical referrals can be made.
- Discuss appropriate testing to uncover PCOS and insulin resistance.
- Discuss current medical treatment for PCOS and insulin resistance.

A Few Definitions:

Hypertrichosis – (1) A growth of coarse, terminal hair which is considered excessive for the age, sex, and race of the individual. It is an overdevelopment of localized extent, and its causes are not always clear. However, the hair growth does not follow a male sexual pattern, and hypertrichosis is *not* considered to be androgen dependent. (2) Overgrowth of nonsexual hair in males or females.

Sexual Hair – Terminal hairs which grow as a result of hormonal changes at puberty. In males, this growth includes hair on the axilla (underarms), pubic hair, beard and chest hair. In females, normal sexual development includes the growth of axilla and pubic hair.

Hirsutism – (1) A condition of wider, general growth of excessive terminal hair in an adult *male* sexual pattern. It can be accompanied by other male-type characteristics; is usually androgen induced, occurring in conditions where there is hormone imbalance, for example, tumor of the adrenal or pituitary glands, problems of ovarian origin, or menopause. (2) Male pattern hair growth in a female. An increase in the amount of hair and/or the coarseness of hair.

Insulin – Insulin is the hormone responsible for getting energy, in the form of glucose (blood sugar), into our cells.

PCOS – Polycystic Ovarian Syndrome. Also known by many as Stein–Leventhal syndrome, is a condition associated with multiple cysts in the ovaries, elevated androgen levels and irregular menses.

Hyperandrogenism -- elevated serum testosterone and androstenedione.

Hyperinsulinemia -- elevated fasting blood insulin levels.

Anovulation – absence of ovulation.

Oligomenorrhea – abnormally infrequent menstruation.

Polycystic Ovarian Syndrome (PCOS)

Electrologists have been familiar with PCOS for decades. Since the condition is commonly responsible for excess hair growth it is safe to say that practically all electrologists have worked with PCOS patients at some time or another.

This is a complex endocrine disorder in women that is characterized by an elevated level of male hormones (androgens) and long-term absence of ovulation (anovulation). These hormonal changes to the ovaries cause multiple follicles to accumulate in the ovaries without ovulation. The ovary then secretes higher levels of testosterone and estrogens. This results in irregular or no menses, excess body hair growth, occasionally baldness, and often obesity, diabetes and hypertension. It is one of the most common hormonal disorders and is responsible for a substantial proportion of cases of female infertility.

The condition also appears to have a genetic component and those effected often have both male and female relatives with adult-onset diabetes, obesity, elevated blood triglycerides, high blood pressure and female relatives with infertility, hirsutism and menstrual problems.

In PCOS, a cycle starts wherein the body becomes resistant to insulin. In order to compensate for this, the body releases more and more insulin. This condition is called hyperinsulinemia. The ovaries of PCOS women seem to be particularly sensitive to high blood levels of insulin and respond by overproducing androgens (such as testosterone). This disrupts the "feedback loop" between the ovaries and the pituitary gland, and the pituitary gland produces too much LH (luteinizing hormone). This leads to *more* overproduction of androgens. These immature follicles in the ovaries then fail to convert all of these excess androgens to estrogen, which inhibits the development of the follicle. Ovulation doesn't take place because the egg couldn't develop properly, and the immature egg, instead of being released from the ovary, becomes a tiny cyst that starts producing its own supply of androgens, which interferes with next month's developing follicle. It’s a vicious cycle.

High Insulin levels due to insulin resistance may be a primary cause of this condition. These high insulin levels can cause the increased androgen levels. Although, in some cases, the insulin resistance is a genetic abnormality.

PCOS affects 6% - 10% of all women of childbearing age regardless of race or nationality. Symptoms usually present themselves during puberty but may also begin in the early to mid 20s, but because symptoms can be mild the disease is often not diagnosed until a woman is experiencing difficulty to conceive. Certain symptoms are life long, the others will cease at menopause.

Symptoms of PCOS

Additional symptoms include hirsutism and acne, which result from high androgen levels. Anovulation may manifest as irregular or absent menses, excessive bleeding, and infertility. Diabetes with insulin resistance or hyperinsulinemia is most often associated with PCOS. Another common feature is obesity. Usually, but not always, the ovaries are enlarged and contain many (8-10 or more) follicular cysts of 10 mm or smaller. This process is related to the ovary's failure to release an egg (ovum). Affected individuals exhibit a wide variety of signs and symptoms, and for this reason some authorities think the syndrome is not one but several different syndromes. Symptoms can be mild or severe, and can vary widely from woman to woman. This is part of the reason doctors often miss the diagnosis. Someone with PCOS may have one or all of the following symptoms in varying degrees:

- Irregular periods: abnormal, irregular, heavy or scanty (oligomenorrhea)
- Absent periods (amenorrhea)
- Polycystic ovaries (seen on ultrasound)
- Hirsutism (excessive hair growth on the face, chest, abdomen, etc.) which seems to worsen with time.
- Alopecia (male-pattern hair loss)
- Obesity/weight gain (particularly around the waist - the "apple" shape as opposed to the “pear” or “hourglass” shape which is more typical for women).
- Acne
- Insulin resistance (now thought to be a *cause* rather than a symptom)
- Skin tags
- Acanthosis nigricans (darkening of the skin under the arms and breasts and at the nape of the neck).
- High cholesterol levels
- High blood pressure
- Exhaustion and/or lack of mental alertness
- Decreased sex drive
- Excess "male" hormones, such as androgens, DHEA’s, or testosterone
- Infertility or reduced fertility
- Decreased breast size
- Enlarged clitoris (rare)
- Enlarged ovaries
- Enlarged uterus

Note that symptoms can worsen over time or with weight gain.

In addition, women with PCOS appear to be at increased risk of developing the following health problems during their lives:

- Insulin Resistance
- Diabetes
- Lipid abnormalities
- Cardiovascular Disease
- Endometrial Carcinoma (Cancer)

The term polycystic ovarian syndrome is somewhat of a misnomer. When Irving F. Stein and Michael L. Leventhal originally described the disease in 1935, they considered the cyst-containing ovaries to be a distinguishing feature; however, anovulation and an elevated level of androgens, not ovarian cysts, are now considered essential for diagnosis of the condition.

Although polycystic ovaries can be one of the symptoms, they aren't present in all sufferers, making the most common name of the syndrome confusing. It is not understood why one woman who demonstrates polycystic appearing ovaries on ultrasound has regular menstrual cycles and no signs of excess androgens while another develops PCOS. In addition many women without PCOS have polycystic ovaries but none of the other symptoms so it is important to understand the difference between the syndrome and having only polycystic ovaries.

One of the major biochemical features of polycystic ovary syndrome is insulin resistance accompanied by hyperinsulinemia.

PCOS is sometimes called "hyperandrogen anovulation syndrome" which describes its hormonal imbalance and associated problems with ovulation better. But since the term PCOS or Polycystic Ovarian Syndrome has been used by the medical profession since the early 1930s it is almost too entrenched in medical literature to change to a more appropriate term.

Excessive androgen secretion, which chronically stimulates estrogen production and disrupts the monthly menstrual cycle, is responsible for the development of the disease. The site of androgen overproduction may vary, but the ovaries are thought to be the main source of the hormones. The disease develops as excess androgens are converted to estrogen, which stimulates the release of gonadotropin-releasing hormone (GnRH) from the hypothalamus and inhibits the secretion of follicle-stimulating hormone (FSH) from the pituitary. GnRH also acts on the pituitary to produce lutenizing hormone (LH), which stimulates the ovaries to produce more androgens, completing the cycle. The underlying cause of androgen overproduction by the ovaries is not fully understood.

New research is suggesting that the cause of the overproduction of testosterone by the ovaries is due to the inability of the woman to process insulin effectively.

This is called Insulin Resistance or Hyperinsulinemia (both pre-diabetic conditions). When insulin levels in the blood are too high, the ovary reacts by producing more testosterone.

The inability of the woman to process the insulin can lead to obesity. Although not all women with PCOS are obese, this has been seen in the past as a diagnostic symptom. Research in the past 10 years has established that PCOS can affect women who are underweight and as well as those who are a normal weight. The so-called "thin" sufferers can also have impaired insulin processing.

Even if specific symptoms are not causing an immediate problem, PCOS can have significant long-term effects, including diabetes, heart disease, and endometrial or breast cancer. It is easy to see why seeking treatment is critical.

According to the Department of Obstetrics and Gynecology at the Pennsylvania State University College of Medicine in Hershey, Pennsylvania, “approximately 50% to 70% of all women with PCOS have some degree of insulin resistance, and this hormone insensitivity probably contributes to the hyperandrogenism that is responsible for the signs and symptoms of PCOS. Although uncertainty exists, early detection and treatment of insulin resistance in this population could ultimately reduce the incidence or severity of diabetes mellitus, dyslipidemia, hypertension, and cardiovascular disease. Even if that proves to be the case, there are still several problems with our current approach to insulin sensitivity assessment in PCOS, including the apparent lack of consensus on what defines PCOS and "normal" insulin sensitivity, ethnic and genetic variability, the presence of other factors contributing to insulin resistance such as obesity, stress, and aging, and concern about whether simplified models of insulin sensitivity have the precision to predict treatment needs, responses, and future morbidity.”

What Causes PCOS?

The root cause of PCOS is an inability of the body to properly process insulin. Insulin is the hormone produced in the pancreas that allows your body's cells to absorb energy from the food you eat. This means that your cells do not respond to the normal amount of insulin, so the pancreas pumps out even more. That's what insulin resistance is and it happens when the body turns both simple and complex carbohydrates into glucose that surges into the bloodstream. Insulin travels to the muscle cells, telling them to take glucose from the bloodstream and store it in the liver. As insulin levels in the blood increase, glucose levels in the blood decrease. When blood glucose falls below a certain level, the brain, which needs glucose to function, calls out for more by telling you to eat again. If it doesn't get glucose, the result is drowsiness or lack of mental alertness. This glucose shortage is also known as low blood sugar or hypoglycemia. When hypoglycemia strikes, the liver is unable to replenish blood glucose from its stored supply because eating a carbohydrate-rich meal or drinking a sugary

beverage creates an exaggerated insulin response that prevents delivery of the glucose. So, insulin remains in the bloodstream, sending messages to store more body fat and preventing the release of already-stored fat, and glucose remains in the liver instead of going to the brain. In addition, the high levels of insulin stimulate the ovaries to produce large amounts of the male hormone testosterone, which may prevent the ovaries from releasing an egg each month, causing infertility. Last but not least, it is the insulin problem that puts us at increased risk for diabetes as well as heart disease.

How is PCOS diagnosed?

Many of the symptoms of PCOS are often considered unrelated by the sufferer and their physician. Women often complain to their doctor about one symptom at a time and the treatment is usually given for that one symptom. It is not until a history is developed that both physician and patient can see that all the symptoms point to PCOS and treatment should begin to treat all aspects rather than each symptom.

There is no single, quick test to identify PCOS. Diagnosis is dependent upon the knowledge and skills of the physician to piece together the symptoms from the patient history and physical appearance. A number of tests can be performed to confirm other symptoms of the syndrome such as hormonal imbalances. The following tests may be ordered by the physician to confirm a diagnosis together with the medical history of the patient.

- Ultrasound, to assess whether ovaries are enlarged and cystic.
- Blood tests, to detect elevated levels of androgen and elevated fasting insulin levels.
- Blood test to detect high levels of LH (luteinizing hormone) or an elevation in the ratio of LH to FSH (follicle stimulating hormone).

The physician should also try to rule out other possible causes of irregular menstruation and excessive hair growth, such as Cushing's syndrome (overactive adrenal gland), congenital adrenal hyperplasia, or other disorders of the pituitary or adrenal glands. Adrenogenital syndrome and ovarian androgen secreting tumors can produce this syndrome but a serum testosterone test is used to screen for these.

Ultrasound findings often include multicystic ovaries with the follicle cysts lining up on the periphery of the ovary but it does not always meet the criteria of ten or more follicle cysts in each ovary. For the women who have classic polycystic ovaries when they undergo ultrasound scanning, only 50% have the classic hirsutism and anovulation. Of women who are felt to have polycystic ovarian syndrome on a clinical and laboratory basis but not on ultrasound criteria, 66-82% have the classic ultrasound appearance expected of polycystic ovaries.

Usually a good diagnosis includes both anovulation and excessive androgen (testosterone) production, but many related conditions have become lumped together in the literature under the term polycystic ovarian syndrome. Woman with polycystic ovaries on ultrasound do not all have androgen excess, but insulin resistance is present in comparatively equal numbers or occurrences. Because of these diverse occurrences the conditions that are collectively referred to as polycystic ovarian syndrome may include:

1. Traditional PCOS -- anovulatory, increased androgens, no insulin resistance
2. Endocrine syndrome X -- anovulatory, increased androgens, insulin resistance or type 2 diabetes (When insulin resistance is found along with high blood pressure, high triglyceride levels, decreased HDL [good cholesterol] and obesity, it is sometimes termed "Syndrome X").
3. Non-traditional PCOS --anovulatory, normal androgens, obese, insulin resistant or type 2 diabetes
4. Non-traditional PCOS -- ovulatory, increased androgens, mild insulin resistance
5. Idiopathic Hirsutism – ovulatory, increased androgens, no insulin resistance

In the past it was thought that PCOS was caused entirely by excess androgen production, but recent research has shown that the factor that causes the problem is insulin resistance and hyperinsulinemia, which in turn cause overproduction of androgens. Treatment previously revolved around treating the androgen imbalance, and wasn't necessarily very effective. Newer treatments focus on the insulin problems and are showing great promise.

Methods of Treatment

The treatment goals should be the restoration of ovulation and the decrease of testosterone levels.

Treatment of the disease usually attempts to suppress excess androgen production. Hirsutism in women who do not wish to become pregnant can be treated with oral contraceptives. Infertility usually is treated with clomiphene citrate, which induces ovulation, but laparoscopic surgery is sometimes used.

Traditional treatments have been difficult, expensive and usually have limited success when used alone. Infertility treatments include weight loss diets, ovulation medications (clomiphene, follistim, Gonal-F), and ovarian drilling surgery. Other symptoms have been managed by anti-androgen medication (birth control pills, spironolactone, flutamide or finasteride).

Ovarian drilling can be performed at the time of laparoscopy. A laser fiber or electrosurgical needle is used to puncture the ovary 10-12 times. This treatment usually results in a dramatic lowering of male hormones within days. Studies

have shown that up to 80% of the women who are treated with this therapy will benefit. Many who were unable to ovulate with clomiphene or metformin therapy will respond to these medications after ovarian drilling. As an interesting side note, women in these studies who are smokers rarely responded to the drilling procedure. Side effects include the formation of adhesions or ovarian failure if the procedure is performed by an inexperienced surgeon. For this reason, ovarian drilling or ovarian wedge resection are considered by some as a last resort treatment because adhesions will usually worsen infertility issues.

Recently there have been some promising new treatment options that have been made available. It has been shown that lowering serum insulin concentrations with metformin (Glucophage 1500 mg a day) improves hyperandrogenism by reducing the ovarian enzyme activity that results in male hormone production.

Metformin (Glucophage) has been used in women with PCOS and insulin resistance to induce ovulation. Finasteride (Propecia®) may be used to reduce hirsutism. Saw palmetto in a dose of about 320 mg per day may be effective in reducing the effect of the androgens since it blocks the effect of 5-alpha-reductase on their receptors. Estrogens in the form of birth control pills or with added progestins can regulate any abnormal bleeding as well as decrease some of the androgen excess.

Ovarian diathermy (heat) or electrocautery during laparoscopy may be useful to induce ovulation if medications have been unsuccessful.

PCOS treatment decisions depend on symptoms, age, whether or not the patient wants to become pregnant, and the degree of ovarian, adrenal and androgen excess. First line management includes diet modification, weight loss and stress reduction since obesity and stress can contribute to androgen excess. Other management and treatment approaches are directed at addressing specific symptoms (i.e. acne, excess hair growth, menstrual problems, infertility) and at preventing long-term complications.

What can the patient expect from this condition?

The anovulation will persist until menopause. After age 40, women with polycystic ovarian syndrome will usually have similar lipid profiles to matched control women without polycystic ovaries. However there does seem to be some worsening of heart disease because women with more severe arteriosclerotic changes will have a higher incidence of polycystic ovarian disease.

Women with PCOS have an increased risk of developing a number of other health conditions. This does not mean that if you have PCOS you are destined to develop any of these problems. It just means that you may be in a higher risk category than the general population.

- **Type II (adult-onset) diabetes** – (non-insulin dependent) By controlling the production of insulin and with changes in diet, this risk can be reduced. If it isn't treated, there is up to a 40% risk of developing diabetes by age 40.
- **High cholesterol and triglyceride levels**
- **Cardiovascular disease** – By controlling the production of insulin, this risk can also be greatly lowered. Cholesterol levels have often been seen to drop down to normal levels during treatment.
- **Endometrial cancer** (cancer of the uterine lining) – This risk comes from lack of menstruation. If you haven't reached menopause and aren't having periods on your own on a semi-regular basis, you may risk developing endometrial cancer.

Insulin Resistance

What is it?

Insulin is a hormone that regulates the transportation of sugar from the blood into cells to be used as fuel. Insulin resistance occurs when insulin is less active than it should be, or when cells are for some reason unable to respond to insulin. This leaves higher than normal levels of sugar circulating in the blood, which can lead to diabetes and many other health problems.

Insulin resistance appears to be a common feature and a possible contributing factor to several frequent health problems, including type 2 diabetes mellitus, polycystic ovarian disease, dyslipidemia, hypertension, cardiovascular disease, sleep apnea, certain hormone-sensitive cancers, and obesity.

One out of every four people in the U.S., or 80 million Americans, have insulin resistance and they are more prone to heart disease, even though they never actually develop diabetes. Excess cardiac risks found with an “apple” figure include: higher triglyceride levels, lower HDL (protective ‘good’ cholesterol), higher blood pressure, diabetes (Type II – non-insulin dependent), and kidney disease. Often there is a family history of high blood pressure, heart disease, diabetes, or cholesterol problems.

A person who is insulin-resistant has cells that respond sluggishly to the action of insulin. Following a meal, this person will have elevated glucose circulating in the blood, signaling yet more insulin to be released from the pancreas until the glucose is taken up by the cells.

Symptoms of Insulin Resistance:

- Early Day Irritability-late day drowsiness
- Wanting additional sweets after meals
- Eating to over-fullness

- Intense need for food before meals
- Craving for pasta, sweets or starchy vegetables
- Weight gain
- Poor sleep habits
- Depression
- Inability to lose weight even on a restricted diet
- Believing that other people eat more than they do.
- Central Obesity
- Abnormal Hair growth or loss
- Menstrual Irregularities
- “Hot flashes”
- Hyperhidrosis (excessive perspiration)
- Hypertension-mild (high blood pressure)

What are some of the associated conditions of Insulin Resistance?

- Type II diabetes – non-insulin dependent. A mild, often asymptomatic form of diabetes mellitus with onset peaking after age 40. Pancreatic insulin reserve is diminished but is nearly always sufficient to prevent ketoacidosis and dietary control is usually effective.
- Hypertension – high arteriole blood pressure.
- Dyslipidemia –
- Atherosclerosis – clogging (lipids/fats) of the arteries.
- PCOS

Tests for Insulin Resistance

There are two very effective tests that are generally recommended to diagnose insulin resistance. They are:

C-Peptide – A blood test for liver enzymes that trigger insulin production. If these enzymes are elevated, then your insulin levels will be elevated.

Fasting Insulin -- A blood test for finding out how much glucose (sugar) is in the blood. This test is usually performed in the morning after the patient has not eaten (approximately 6-8 hours) since the previous evening. These readings should be in the mid ‘80’s. If the glucose is measured at over 120 then the condition is considered to be diabetic. The insulin levels should measure between 2-5. Anything at 10 or over indicates a severe problem.

Diet and Exercise

Avoid the foods that cause your blood sugar to rise quickly. These include all types of flour products: bread, spaghetti, macaroni, bagels, rolls, crackers, cookies and pretzels; refined corn products and white rice; and all sugar added products. Eat lots of vegetables, un-ground whole grains, beans, seeds and nuts. Eat fruits and root vegetables (potatoes, carrots and beets) only with other foods.

The ideal diet for modifying insulin resistance should reduce body weight, decrease fat while sparing muscle tissue, and improve insulin sensitivity.

Insulin resistance may be helped by good dietary choices and regular exercise, particularly progressive resistance (weight) training. Watch out for low fiber foods and foods high in sugar and fat, especially saturated fats. Stick to high fiber foods; get your carbohydrates from whole grains instead of refined (white) grains and sugar; use olive oil instead of butter or shortening. Eat small, frequent meals and snacks with a mix of carbohydrates, protein, and fat.

Obesity, especially when fat accumulates in the abdominal region ("apple shape"), increases the severity of insulin resistance and has been associated with insulin resistance. Loss of excess weight tends to improve insulin sensitivity (i.e., reduce insulin resistance).

Alcohol consumption in the light to moderate range is associated with better insulin sensitivity in healthy, non-diabetic people. Since alcohol consumption also reduces other risk factors for heart disease, it does not appear that people with insulin resistance would benefit from avoiding alcohol if they are currently light to moderate drinkers.

Exercise may be the single most important lifestyle factor for both preventing and reversing insulin resistance. Even an exercise routine as simple as incorporating brisk walking four times weekly dramatically improves endurance fitness, decreases body fat stores, tends to reduce food consumption, and decreases insulin resistance.

The benefits of exercise on insulin resistance appears to hold consistently across all age groups and both sexes. In a study of obese children, it was observed that four months of exercise training improved insulin resistance and other metabolic factors associated with Syndrome X. These benefits were subsequently lost when the children became less active.

Although exercise is a critical intervention to address insulin resistance, the combination of dietary modifications with exercise is probably an even more effective strategy.

Lifestyle Modifications and Insulin Resistance

The stark reality is that a majority of people with this metabolic problem developed insulin resistance as a result of a lifetime of cumulative poor choices. Factors thought to contribute to insulin resistance include diet, exercise, smoking, and stress. Although there are certainly genetic factors contributing to this metabolic state, since the above factors are all modifiable to a greater or lesser degree, insulin resistance is potentially preventable. Even among those members of the population with a genetic propensity for this metabolic challenge,

it appears appropriate lifestyle choices play a large part in its manifestation and reversal.

Stress

While the role of stress in the development of insulin resistance is still vague, it appears that stress and the physiological response to stress is a hurdle that might interfere with efforts to improve insulin sensitivity. Acute stress is clearly associated with a severe, yet reversible, form of insulin resistance.

Survey

You will find a survey at the end of this home study booklet that was developed by Mrs. Shelby Owens, CME and Dr. Karen Snow. You are encouraged to use this survey in your hair removal clinic. Additionally, Mrs. Owens and Dr. Snow would like to receive your completed surveys if you choose to include your confidential data in their research project.

Natural Remedies

Much has been written on insulin resistance and natural methods of addressing the condition.

Nutritional Interventions & Supplements

The following nutritional supplements have been found to improve the condition of insulin resistance.

Minerals

- **Magnesium** – magnesium deficiency results in impaired insulin secretion while magnesium replacement restores insulin secretion.
- **Calcium** – patients treated with calcium had decreased fasting plasma insulin levels and a significant increase in insulin sensitivity.
- **Potassium** – a potassium-depleted diet was found to lead to insulin resistance at post-receptor sites.
- **Zinc** – an implied clinical correlation between low zinc levels and insulin resistance have been found.
- **Chromium** – animal experiments have shown that a deficiency in chromium can result in insulin resistance.
- **Vanadium** – vanadium, as vanadyl sulfate, is a trace mineral associated with sugar regulation. It is believed to regulate fasting blood sugar levels and improve receptor sensitivity to insulin.

Vitamins

- **Biotin** – in experimental models of type II diabetes, biotin lowered post-prandial (after a meal) glucose levels, improved insulin response to a glucose load, and decreased insulin resistance.

Amino Acids

- **L-Carnitine** – was found to be capable of reducing the associated trend toward insulin resistance.
- **Taurine** – an animal study resulted in significantly less abdominal fat accumulation, hyperglycemia, and insulin resistance.
- **L-Arginine** – studies found that serum insulin concentrations were significantly lower 30 minutes after arginine infusion.
- **Glutamine** – an amino acid which has been shown in animal studies to prevent high blood sugar and insulin levels in mice that were susceptible to developing high sugar levels when fed a high-fat diet.
- **Glutathione** – study groups experienced increased glucose uptake, suggesting enhanced insulin sensitivity.

Additional Supplements

- **Polyunsaturated Fatty Acids (omega-3 and omega-6 fatty acids)** – Help keep cell membranes flexible. Flexible cell membranes have more and better insulin receptors, which improves glucose metabolism. Flax seed and some kinds of deep-sea fish have them - you can get it in capsules too - borage oil, black currant oil, evening primrose oil, flax seed oil, fish oil.
- **Coenzyme Q10** – CoQ10 has been shown to lower glucose and fasting insulin levels, suggesting possible improved insulin resistance.
- **Alpha Lipoic Acid (ALA)** – Studies have shown ALA to improve insulin sensitivity up to 25%. It is said to reduce pain and debility in diabetic neuropathy. It can be given intravenously or orally at a dose of 300 mg.
- **a-Lipoic Acid** – can improve insulin sensitivity in patients with diabetes.
- **R-Lipoic Acid** – has been shown to increase the permeability of cell membranes. The body cannot handle glucose properly if the cell membrane restricts glucose to pass through it.
- **Cinnamon** -- 1/2 to 3/4 tsp. of cinnamon with every meal helps keep insulin & blood sugar levels under control. It contains a phytochemical called methyl hydroxy chalcone polymer (MHCP) which improves cellular glucose utilization and increases the sensitivity of insulin receptors. Studies have shown dramatic fall in fasting blood glucose levels. Cinnamon has also been shown to reduce cholesterol, triglycerides and LDL cholesterol.
- **Aloe Vera** – May be taken in liquid, capsules or gel form. Aloe vera has been shown to significantly reduce blood sugar levels.
- **Chromium Picolinate** – Improves glucose tolerance. Results of a four-month study demonstrated that daily supplementation with 1,000 mcg of chromium picolinate significantly enhanced the action of insulin. A dosage of 50-100 mcg daily is high enough to correct a deficiency, but not sufficient to improve blood sugar control.

- **Grapefruit** – Contains organic acids that act as tiny fatty acids that are very easy for your body to burn. When they enter your stomach, they slow your body's digestion of carbs. The result is lower blood sugar.

"Targets" of Insulin Resistance

Female:
- Lip
- Sideburns
- Under the Chin
- Mid Chest
- Lower Abdomen
- Forearms
- Feet

Male:
- Back
- Shoulders
- Ears
- Forearms

You will find photographs at the end of this home study booklet that demonstrate diagnosed cases of PCOS and insulin resistance. You will no doubt recognize these target areas as cases that you have routinely seen and treated in your own hair removal clinic. Most of these photos are the property of Shelby Owens, CME, and have been used with her permission.

Approximately 17 million people in the United States, or 6.2% of the population, have diabetes. While an estimated 11.1 million have been diagnosed, unfortunately, 5.9 million people (or one-third) are unaware that they have the disease.

Cost of diabetes in the United States (figures from 2002)
- **Total (direct and indirect)**: $132 billion
- **Direct medical costs**: $91.8 billion
- **Indirect costs**: $39.8 billion (disability, work loss, premature mortality)

Role of the Electrologist

The electrologist is often the first professional to observe the symptoms for insulin resistance. With the training that we have received and the questions that we have learned to ask and record, we have been able to "put two and two together". We have the ability to recognize the symptoms in many patients in time to help them prevent the onset of diabetes and the host of other conditions that come with that disease. We need to convince our 'suspected' patients to request their physicians to order these tests. Additionally, we need to be able to discuss these markers with the patient's physician if requested. We can also help monitor the patient's response by observing their hair growth (removal) progress. With these tools, we are capable members of the health care team.

REFERENCES:

Principles and Techniques for the Electrologist, by Ann Gallant. Stanley Thornes (Publishers) Ltd., 1993

Encyclopedia Britannica 2007

NHS Direct Online Health Encyclopaedia
http://www.nhsdirect.nhs.uk/en.asp?TopicID=362

Polycystic Ovarian Syndrome Association of Australia
http://www.posaa.asn.au/

Polycystic Ovary Syndrome... Treatment with Insulin Lowering Medications
by Mark Perloe, M.D.

American Heritage Dictionary

Dorland's Pocket Medical Dictionary, 25th Edition

Diabetes Services, Inc.
http://www.diabetesnet.com

Insulin Resistance: Lifestyle and Nutritional Interventions
Gregory S. Kelly, ND

HealthNotes
www.healthnotes.com

Treatment of Insulin Resistance
Gabe Mirkin, M.D.

Medline Plus Medical Encyclopedia
http://www.nlm.nih.gov/medlineplus/ency/article/003482.htm

American Diabetes Association
http://www.diabetes.org/main/info/facts/facts.jsp

http://www.diabetes.org/main/application/commercewf?origin=navigation.jsp&event=link(B)

Natural Remedies for PCOS and Insulin Resistance
http://pcos.freeservers.com/natural.html

General Information About PCOS – 2007
http://diabetes.org/type-1-diabetes/PCOS.jsp

medifocus
http://www.medifocus.com/guide_detail.asp?gid=ND014&a=a&assoc=Google&keyword=polycysticovary

Family Practice News, September 15, 2005

Fujoka K.F. Greenway, et al “The effects of grapefruit on weight and insulin resistance: relationship to the metabolic syndrome,” *j Med Food* 2006, 9(1): 49-50

Medicine Net
http://www.medicinenet.com/insulin_resistance/article.htm - 04/26/2006

Sarti C, Gallagher J. The metabolic syndrome: prevalence, CHD risk, and treatment. *J Diabetes Complications*. Mar-Apr 2006;20(2):121-32.

Ratner RE,. An update on the Diabetes Prevention Program. *Endocr Pract*. Jan-Feb 2006;12 Suppl 1:20-4.

Legro RS, Castracane VD, Kauffman RP. Detecting insulin resistance in polycystic ovary syndrome: purposes and pitfalls. *Obstet Gynecol Surv*. Feb 2004;59(2):141-54.

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