Understanding and Managing
POLYCYSTIC OVARIAN SYNDROME (PCOS)

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INTRODUCTION

Polycystic Ovary Syndrome, more commonly referred to as PCOS, is an endocrine, reproductive and metabolic disorder that is characterized by diverse clinical symptoms including irregular menstrual cycles, infertility, hyperandrogenism with subsequent hirsutism, insulin resistance (IR), acne, weight gain and cystic ovaries. PCOS is the leading cause of infertility in women in the United States. In fact, between 2-18% percent of women in North America have PCOS (Stansbury 2012, 11), and because so many women with PCOS go undiagnosed, it's hard to pin down a more precise percentage. Not only can PCOS lead to infertility but, if left untreated, it can result in a host of other serious health problems including type two diabetes, high blood pressure, high cholesterol, thyroid disease, cardiovascular disease and an increased risk for reproductive cancers. While there is not full consensus in the scientific community about the exact cause or cure for PCOS, there are ways that women can manage the syndrome so as to improve their health, reduce symptoms, boost fertility and increase the overall quality of their life. The aim of this paper is to clearly explain the pathology and physiological consequences of PCOS and discuss ways that women can use allopathic medicine, herbal medicine, diet and lifestyle strategies to keep symptomology to a minimum and improve health and vitality.

PART 1: UNDERSTANDING PCOS

PCOS has been described in medical literature for over two centuries. In 1845, a French manuscript described sclerocystic ovaries. It was later coined "Bearded Ladies Diabetes" as the correlation between excess androgens and diabetes was becoming evident. In 1935, two doctors, Stein and Leventhal, described a syndrome associating excessive male-patterned hair growth, obesity and menstrual cycle disturbance leading to infertility (Thatcher 2000). This became known as Stein-Leventhal Syndrome. In the years since, extensive research has looked into the causes of Stein-Leventhal Syndrome and searched for ways to manage it. This syndrome is now referred to as PCOS. As you will see in this section, PCOS is very complex in its origin, with a host of different signs

and symptoms. However, understanding how PCOS manifests itself in a woman's body allows for accurate diagnosis and treatment.

1.1 PATHOPHYSIOLOGY OF PCOS

PCOS has a complicated, and not fully understood or scientifically agreed upon pathophysiology. The disorder has very diverse and significant clinical implications for women who suffer from it ranging from reproductive health, to endocrine and metabolic abnormalities. Below is a flow chart that outlines some of the factors that contribute to the pathophysiology of PCOS. Following the chart is an outline of how these processes take place in the body. Keep in mind that no two people are the same and the reason one woman has PCOS may be very different from the next.

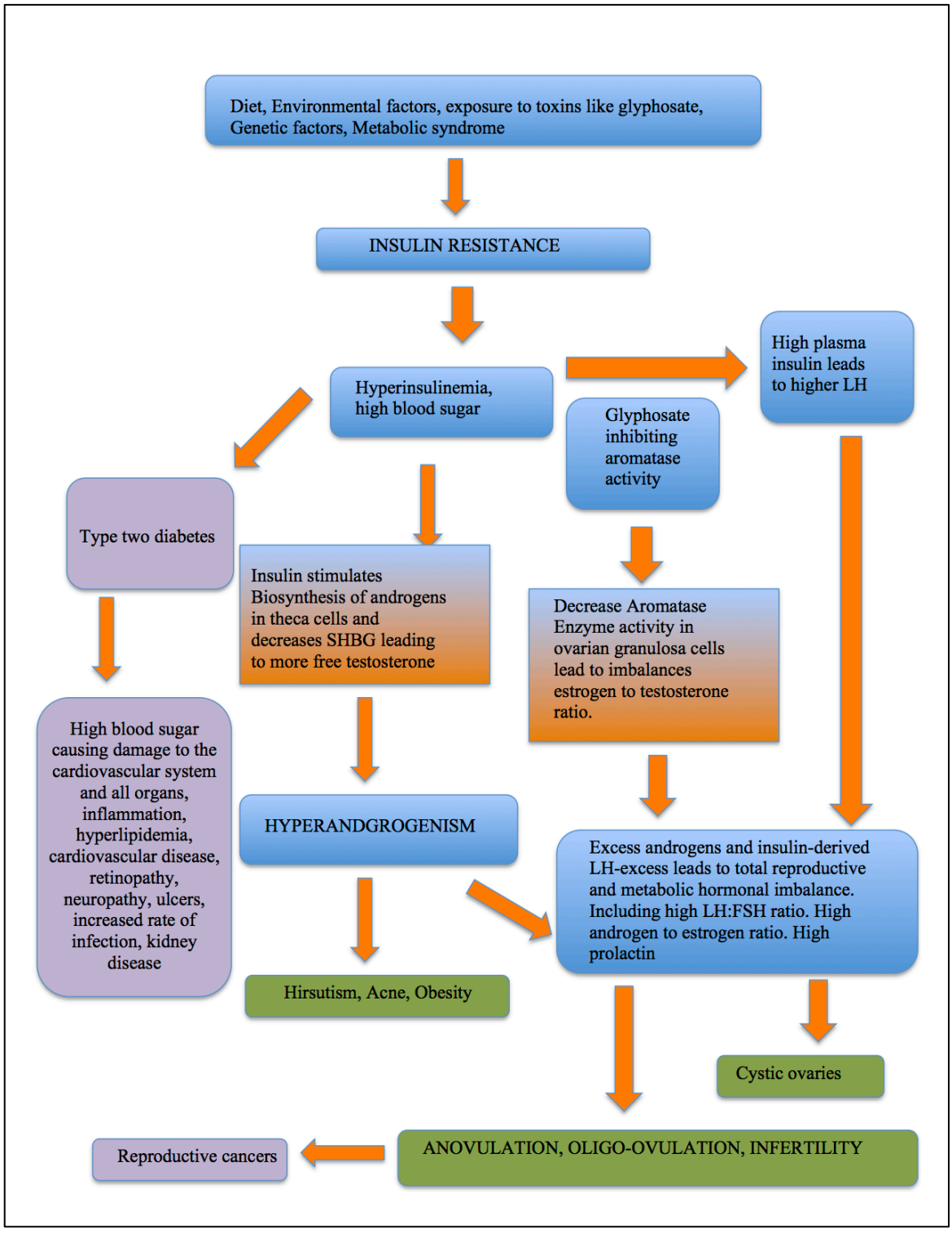

Figure 1: PCOS PATHOPHYSIOLOGY FLOW CHART

1.1.1 Insulin Resistance and Hyperandrogenism

Insulin is a hormone in the body that is secreted by the pancreas and is responsible for getting glucose from the blood into the body's cells. Insulin does this by attaching to insulin receptors in the various cells throughout the body. Typically, when a person eats and blood glucose rises, the pancreas excretes insulin to help this glucose move from the blood stream into the body's cells to be metabolized. The blood glucose level then drops and the pancreas stops putting out more than the body's basal insulin requirement. When this feedback loop is functioning, blood glucose levels and insulin levels should remain healthily normal. When the cells in the body are not utilizing the insulin properly or resisting the insulin, glucose cannot get into the cells and we end up with high blood sugar and high insulin to compensate, also called hyperinsulinemia (Stansbury 2012). This leads to type 2 diabetes, which has it's own cascade of health problems that will be addressed later on.

As you can see in the chart above, Insulin resistance sets off a cascade of imbalances in a woman as a reproductive and metabolic hormone that contributes to the disordered state of PCOS. Between 40-80% of women with PCOS present Insulin resistance (Thatcher 2000, 16). There are many reasons a woman may develop insulin resistance. Most commonly, across all populations, diet is the biggest contributing factor to the development of insulin resistance and type 2 diabetes. In these cases, people who eat more sugars and simple carbohydrates than the body can handle develop insulin resistance because the body is producing so much insulin in response to high sugar that the body begins to view insulin as something that should not be received – thus making their cells insulin resistant. However, in women with PCOS, there are much more complicated metabolic and reproductive processes happening. Many women who have PCOS show signs of a metabolic disorder pre-puberty and independent of diet. There are also genetic abnormalities that play a role in the development of PCOS; we can see this in the higher rates of PCOS among women in the same immediate family. In more recent years, it is coming to light that environmental toxins and pollutants in our food system, like glyphosate, play a role in the development of insulin resistance and PCOS (Samsel and Seneff 2013). So, while it is important to know why a woman develops insulin

resistance in the first place, it is equally important to understand how insulin resistance contributes to imbalances that further exacerbate PCOS symptoms.

In women with PCOS, insulin resistance and compensatory hyperinsulinemia may actually be the major underlying cause of the disease. Hyperinsulinemia leads to an exaggerated effect of insulin in traditionally less responsive tissues, including stimulating androgen secretion by the ovarian theca cells (Barbieri et. Al 1986). Theca are endocrine cells that play many important roles in folliculogenesis, which is the maturation of an ovarian follicle prior to ovulation. Theca are responsible for producing androgen in the follicle as a precursor to estrogen, they help build structure for growing ovarian follicles before ovulation and they provide a signaling pathway between granulosa cells and oocytes (Young and McNeally 2010). If theca cells are overactive, women experiences infertility due to excess androgens, if they are underactive women experiences infertility due to lack of estrogen as a result of decreased provision of thecal androgen for estrogen synthesis (Magoffin 2005). Typically, Theca cells are stimulated to produce androgens by Luteinizing Hormone (LH). In women with PCOS, LH levels are usually higher than normal and insulin is also producing stimulatory effect to produce androgens – creating an abnormally high amount of androgens. In normal women, these androgens are converted to estrogens in the granulosa cells in the follicle under the influence of follicle stimulating hormone (FSH). In a study by Chen et al, it was found that women with PCOS had higher levels of LH and lower levels of FSH than their non-PCOS counterparts (2015). This high LH/FSH ratio creates a state of hyperandrogenism leading to much of the PCOS symptomology. This will be discussed in the following section on Aromatase activity.

The actual pathway in which insulin acts on the theca that stimulates androgen production is not quite clear. Baillargeon *et* al., believe that, "that defective insulin-mediated release of the d-chiro-inositol-containing inositolphosphoglycan (DCI-IPG) mediator may contribute to the insulin resistance that characterizes obese PCOS women" (2010). IPG's are mediators in the insulin-signaling cascade for glucose uptake. DCI-IPG has been shown to help activate the synthesis of glycogen in muscles and adipose tissue. Women with PCOS have shown decreased insulin stimulated release of DCI-IPG. It is unknown whether this is due to a lack of DCI or if something else is happening. It has

been shown that using DCI supplements have greatly helped women with PCOS lower insulin resistance and high blood glucose (Stansbury 2012).

Beyond this study, the relationship between insulin-resistance in women with PCOS and hyperandrogenism is very clear as we can see based on the graph below. It has also been shown that insulin resistance underlies the development of hyperandrogenism in women with PCOS whereas insulin resistance does not create such androgen excess in non-PCOS women with insulin resistance (DeUgarte 2004. Nestler et al. 1998). This leads many researchers to believe that there is a genetic mutation in women with PCOS where insulin can stimulate the ovaries to make androgens. Studies also show that insulin-sensitizing agents, like Metformin, decrease circulating androgens – further proving the correlation between insulin and hyperandrogenism (Diamanti-Kandarakis and Dunaif 2012).

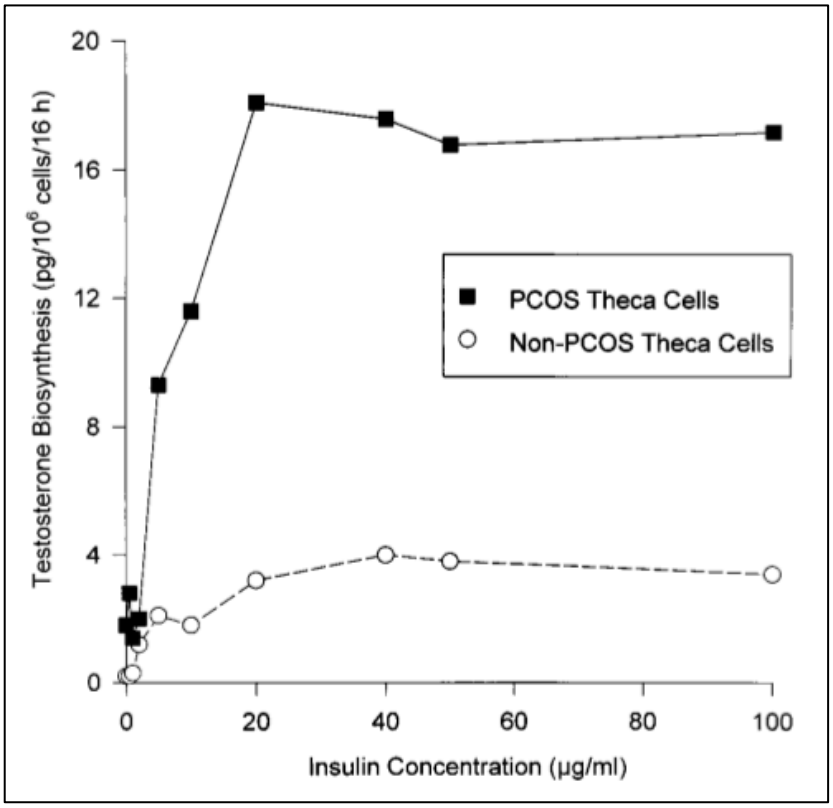

Figure 2: Influence of Insulin on Androgen production by Nester et al 1998.

Beyond increasing circulating androgens, insulin decreases Serum hormone-binding globulin (SHBG) in women with PCOS (Nestler 1997). SHBG is a protein that responsible for binding free testosterone making it unavailable for use. Lower levels of SHBG leads to higher levels of bioavailable testosterone in the blood and we see hyperandrogenism. SHBG levels are also decreased by excess androgens and so, this cycle plays out on itself over and over where androgens rise and SHBG decreases, only to further perpetuate hyperandrogenism (Thatcher 2000).

There are also insulin receptors on the pituitary and here insulin modulates the release of gonadotropins in the anterior pituitary, increasing the pulse frequency of Luteinizing hormone, which stimulates androgen release. This further disrupts the androgen to estrogen to progesterone and the LH:FSH feedback cycle, which contributes to the irregular ovulatory cycles in women with PCOS and subsequent infertility.

1.1.2 Aromatase Enzyme

It has been reported that there is dysfunction of the aromatase enzyme in many women with PCOS. The aromatase-P450 enzyme is responsible for converting androgens (androstenedione and testosterone) into estrogens (estrone and estradiole) during steroidogenesis (Nestler and Jakubowicz 1997). Aromatase can be found in many estrogen producing tissues in the body including placenta, ovaries, testes, skin, bone, adipose tissue, brain and vascular smooth muscle cells. However, for women of reproductive age, the aromatase in ovarian granulosa cells and in luteinized granulosa cells are of great importance. Androgens derived for steroidogenesis are produced in theca cells and are transported to granulosa cells of growing follicles. Here, the aromatase-P450 enzyme converts them to estradiol (E2) in the ovary. Typically this conversion of androgens to estrogens functions in a hormone feedback loop creating a balanced estrogen to testosterone ratio, where estrogen levels boost FSH and LH levels and a normal menstrual cycle occurs. In women with PCOS, it appears that aromatase activity is deficient and that excess androgens are not being converted into estrogens. In fact, androgens inhibit aromatase activity. In PCOS, we see excess androgens, sometimes excess estrogens, higher than normal luteinizing hormone levels and lower than normal FSH levels. This aromatase dysfunction creates an imbalance in the estrogen to

testosterone ratio, which further exacerbates menstrual cycle irregularities (Chen et al 2015). It was shown that a hyperestrogen state could increase aromatase activity. Unfortunately, in many women with PCOS, the estrogen excess is overshadowed by hyperandrogenism and aromatase activity is still inhibited.

The role of aromatase in PCOS goes beyond regulating menstrual cycles, it is also responsible, in part, for regulating BMI. Estrogen has been proven to help lower BMI and glucose levels as estrogen is negatively correlated with BMI (Barrera et al, 2014). Since aromatase is responsible for converting androgens to estrogens and having a more estrogens can help decrease BMI, aromatase activity is very important for women with PCOS, who are, more often than not, obese.

It becomes clear that aromatase activity plays a vital role in the health of women with PCOS in terms of their menstrual cycle, hyperandrogenism and BMI. So, while there still needs to be more research into the role of the aromatase enzyme in PCOS, there may be room to enhance aromatase activity as a strategy for treating PCOS women, particularly those who are obese.

1.1.3 Glyphosate and PCOS

Glyphosate is the main active ingredient in the broad-spectrum herbicide Roundup. Roundup is the most commonly used herbicide in the world with the United States making up 25% of that usage (Duke and Powles 2008). Its use has only increased in the last two decades with the introduction of its genetically modified counterparts, “RoundUp Ready” crops. “RoundUp Ready” crops, manufactured by Monsanto, can survive the application of RoundUp, while other weeds in the fields cannot. This allows farmers to apply RoundUp across their entire fields, thus, introducing more Glyphosate into our food and water supply and the environment. Glyphosate has also been used more recently on wheat and sugar cane to ripen the crop before harvest – this introduces so much more glyphosate onto the crops than was traditionally intended.

Glyphosate is considered by some to be non-toxic to humans because it works by disrupting a metabolic pathway in plants not present in mammals (Herrmann and Weaver 1999). However, this pathway *is* present in mammalian gut bacteria and now we are seeing correlation between glyphosate increase and increase in diseases that are

influenced by disrupted gut bacteria. Recently, there have been many scientific studies focusing on the connection between Glyphosate and chronic diseases that are on the rise in the United States like Celiac Sprue, Autism, Cancer, Parkinson's and reproductive disorders like PCOS (Samsel and Seneff 2013b).

In the Case of PCOS, the connection to glyphosate may lie in the aromatase enzyme. Glyphosate has been shown to affect many enzymes of the Cytochrome P450 family, including aromatase (Gasnier et al 2009). The enzymes in this family perform many functions, which explains the assortment of diseases that glyphosate influences. In one study, Glyphosate was shown to inhibit aromatase activity at levels 100 times lower than the recommended use for agriculture – and these effects were seen in less than 18 hours (Moslemi et al 2005). Because we know that Aromatase is used in converting androgens to estrogens and deficient aromatase activity inhibits this process, it becomes clear that glyphosate's disruption of aromatase plays a vital role in hyperandrogenism in women with PCOS. While glyphosate may not be the only contributing factor to low aromatase activity in PCOS women, it surely proves to be an endocrine disruptor that should be avoided.

Glyphosate also has connection to insulin resistance. In short, long-term exposure to glyphosate causes system wide depletion of sulfate. Sulfate is used in a chemical process in the body, where part of the glucose that goes into the blood after a meal is stored as heparin sulfate in the extracellular matrix in the body (Seneff et al., 2012). Heparin sulfate breaks down after a few hours, providing a temporary buffer for our body to more effectively pull glucose out of our blood serum. Depletion of sulfate inhibits this process, impairs cellular glucose uptake and insulin resistance (Samsel and Seneff 2013a). This pulls us right back to insulin resistance being the underlying cause of PCOS or at least aggravating the majority of symptoms associated with it.

Beyond insulin resistance, glyphosate depletes the plants treated with RoundUp and the people who eat RoundUp exposed food of vital minerals and vitamins. These include vitamin D3, Zinc, Iron, Manganese, Magnesium and so many more. All of these vitamins and minerals are part of the treatment plan that is outlined later.

1.2 SIGNS AND SYMPTOMS OF PCOS

Beyond the pathology of PCOS, there are signs and symptoms that are very common place in women with the disorder. While the pathology of PCOS is important, and some of the factors outlined in the previous section can be apparent in blood test, there are very clear clinical signs and symptoms that prove a woman has PCOS. Symptoms like hirsutism, central obesity, abnormal menstrual cycles and infertility that are most apparent and bothersome to women with PCOS. Below, these signs and symptoms are outlined. Some of these symptoms contribute to the cyclic nature of the disease state.

1.2.1 Abnormal Menstrual Cycle and Infertility

Many women first discover they have PCOS because they are having irregular or absent menstrual cycles. In fact, 50-90% of women with PCOS show some abnormality in their ovulation (Thatcher 2000, 16). Sometimes, PCOS will first become apparent because a young woman will have her first period later than normal and then not have a normal cycle again (Stansbury 2012). The absent or abnormal menstrual cycles are caused by disrupted hormone feedback loop between the pituitary gland and the ovaries. This disruption typically stems from the elevated presence of insulin and androgens in the body. It should also be noted here that some women present many symptoms of PCOS while still maintaining a somewhat normal menstrual cycle – this may be that a healthy diet has kept them from slipping into a more progressed state of insulin resistance.

A normal menstrual cycle is under the control of many hormones. First GnRh, a hormone messenger in our hypothalamus, is released. GnRh tells the pituitary gland to release Luteinizing hormone (LH) and Follicle stimulating hormone (FSH). FSH and LH enter the blood stream and are received by the ovaries. FSH and LH are used for the development of the follicle and the production of estrogen, progesterone and inhibin – which is meant to send a negative feedback to tell the pituitary gland to stop sending FSH. As the follicles grow, they produces estrogen and as the estrogen rises in your body, your womb is getting ready for a fertilized egg by building blood and nutrients. At about day seven of the cycle there is a dominant follicle and all other follicles recede. The dominant follicle is nourishing the egg inside it and also sends out a surge of estrogen to

the pituitary gland. This estrogen triggers the pituitary to release more luteinizing hormone, which triggers the follicle to finish growing and causing the egg to pop out of the follicle and into the abdominal cavity. This is ovulation. Once the egg or oocyte is in the cavity, the fallopian tube comes and sucks in the egg, using cilia and water muscle contractions to move the egg into the uterus. Once in the uterus, if the egg isn't fertilized within 12-24 hours, it will dissolve and be shed along with the uterine lining. The follicle that burst the egg out turns into a progesterone factory (this is called the corpus luteum) and makes progesterone to support a pregnancy. If the egg isn't fertilized, the progesterone stops being produced and without the high levels of estrogen and progesterone to support the lining of the uterus, it starts to break down and will eventually shed from the body and the menstrual cycle starts all over. If the egg is fertilized both progesterone and estrogen will rise back up to support the fetus and carry it through to delivery.

In women with PCOS, this feedback loop that causes a woman to ovulate is completely disrupted. It is very commonly seen in PCOS that LH hormone is higher than average and FSH is lower than average. This alone does not allow for proper hormone feedback between the ovaries and pituitary. High LH causes the ovarian follicles to attempt to develop but without the FSH balance, the never fully mature. If a follicle isn't able to fully develop and ripen an egg, ovulation will not happen (Boss et al 2009). This presents itself as absent or very irregular menstrual cycles and subsequent infertility.

Below are a couple of charts that compare the feedback loops between normally ovulating women and women with PCOS. These charts are from: (http://courses.washington.edu/conj/bess/reproductive/pcos.htm)

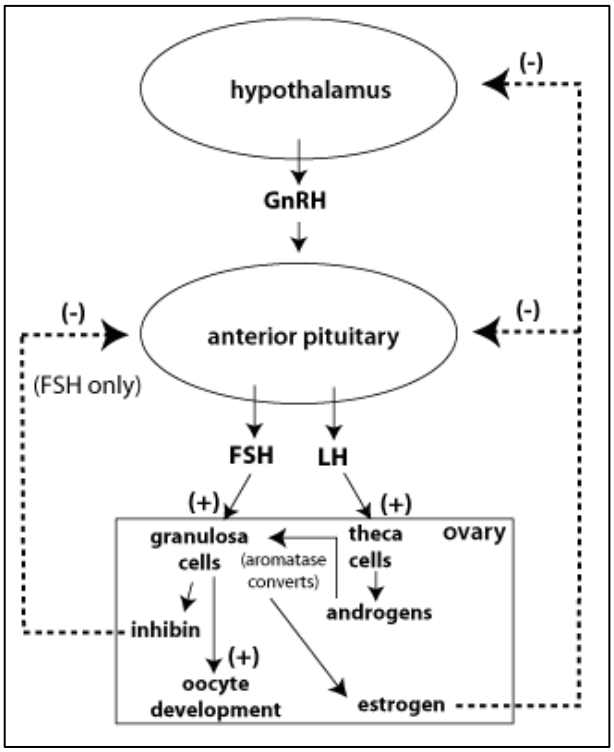

Figure 3: Normal Hormone Feedback Loop

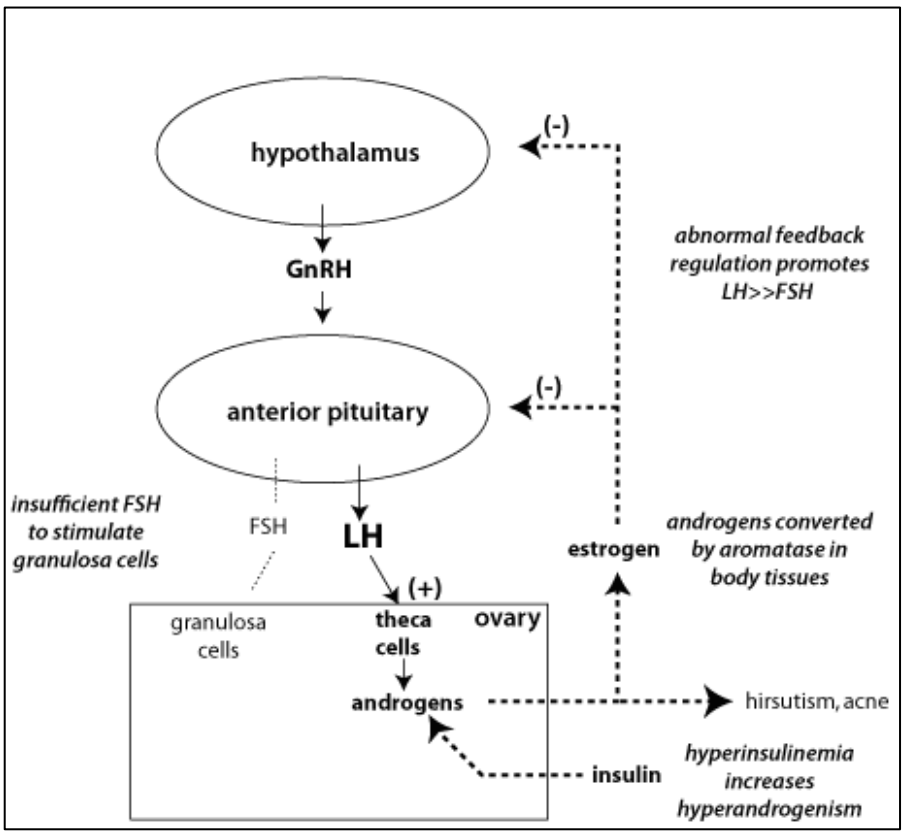

Figure 4: Hormone Feedback Loop in Women with PCOS

1.2.2 Hyperandrogenism and Hirsutism

Androgens are normally present in all people but normal levels vary between men and women. Androgens are anabolic and promote the storing of nutrients and the build up of tissue. In women, androgens are produced in the ovaries, adrenal glands and in fat cells. Androgens play an important role in women's health but, when they aren't in balance, they can cause central obesity, acne and hirsutism.

Hirsutism is male pattered hair growth. (Thatcher 2000). In women with PCOS this most commonly causes thick, course hair growth on the face, chest and back and sometimes hair loss and male-patterned badness. Hirsutism is the most common clinical sign that a woman has hyperandrogenism. Hirsutism is influenced by excess circulating androgens, by the increased number of androgen receptors in the body and by an altered conversion of hormones by the hair follicle.

It is important to note that hyperandrogenism does not cause virilization. Virilization causes deepening of the voice, enlarge clitoris, increased muscle mass and rapidly developing male pattered baldness – if these symptoms are present, there could be significantly more androgens than seen in PCOS and the patient should be tested for ovarian and adrenal tumors (Roush 2010. p.8).

1.2.3 Acne

Acne forms when androgens increase sebum, which is the oily/waxy material that keeps skin waterproof and moist. Sebum comes from the sebaceous glands that lie just under the skin (Boss et al 2009). Excessive sebum can build up in the pores of the skin and get clogged with dirt and bacteria, causing acne. Sometimes this acne is cystic and deep under the skin, other times it will present as a white or blackheads (Roush 2009). Women with PCOS often have very terrible acne that is painful and embarrassing, especially during the sensitive teenage years. Very commonly, acne will remain with these women into adulthood.

1.2.4 Weight Gain and Central Obesity

As I mentioned before, well over 50% of women with PCOS struggle with their weight (Stansbury 2012). Often times, these women may exercise and eat just as well as their friends without the disease and will weigh significantly more. The degree of obesity in women with PCOS is directly correlated with androgen levels, insulin resistance and faulty fat metabolism.

Insulin resistance may cause weight gain because the uptake of glucose into the cells is inhibited. Because the body can only store so much glucose in the liver and muscles (in the form of glycogen), the excess glucose is stored as body fat. This is the process of putting on weight. In a study in 2004, it was found that in a group of women with PCOS, the women who had insulin resistant has a much higher BMI than those with PCOS who didn't have insulin resistance (DeUgarte et al 2004). Also, it was found that the degree of insulin resistance correlates with the degree of obesity – more obese patients presented higher levels of insulin resistance.

Androgens cause central obesity – which is weight gained around the stomach (Boss et al 2009). Elevated levels of androgens in the body promote the storage of sugar and nutrients in the body tissue. This type of obesity carries a much higher risk for cardiovascular disease. Often times weight gain caused by these hormone cycle imbalances can further exacerbate the imbalance and weight loss can help bring hormones into a more balanced place.

It appears also that women with PCOS do not metabolize fat as well. There are hormones like Leptin and cytokines like adipokines that are responsible for directing the metabolism of fat. These levels have found to be abnormal in women with PCOS (Stansbury 2012). It is also believed that cortisol is released in response to inflammation in the body and that this can cause weight gain. Because women with PCOS often have a lot of inflammation –partially due to high blood glucose- inflammation induced cortisol is an important factor to look at.

1.2.5 Cystic Ovaries

Cystic ovaries are found in 23% of women of childbearing age and so, while this disease is named after this symptom, not all women with cystic ovaries have PCOS and

not all women with PCOS have cystic ovaries (Roush 2010. 7). Cysts on the ovaries are formed when an ovarian follicle begins to develop but due to improper hormone balance, cannot develop fully; this leads to numerous immature follicles on the ovaries. These are not technically cysts but have the same appearance. Having numerous immature follicles on the ovaries often causes the ovaries to become enlarged. Typically these cysts are benign and are not a cause for concern or the focus of treatment, unless one wants to get pregnant – and then some western doctors may try to remove them.

1.2.6 Acanthosis Nigricans:

This is a skin disorder that causes patches of the skin to become dark, discolored, thickened and even velvety (Boss et al 2009). These dark patches of skin are typically seen around the neck but are also found in the groin and thighs. Acanthosis Nigricans is associated with insulin resistance. This symptom will typically fade over time as PCOS is managed properly (Roush 2009).

PART 2: DIAGNOSING PCOS

PCOS is so often undiagnosed in women because many of the symptoms associated with PCOS are also symptoms of other diseases and disorders. Over the past two decades, as research has increased on PCOS, different organizations and conventions have come up with criteria for diagnosing PCOS. Below is a table made by the National Institute of Health in 2012, which outlines the different criteria used for determining if a woman has PCOS. (Table extracted from NIH 2012)

NIH 1990	Rotterdam 2003	AE-PCOS Society 2006
• Chronic anovulation • Clinical and/or biochemical signs of hyperandrogenism (with exclusion of other etiologies, e.g., congenital adrenal hyperplasia) *(Both criteria needed)*	• Oligo- and/or anovulation • Clinical and/or biochemical signs of hyperandrogenism • Polycystic ovaries *(Two of three criteria needed)*	• Clinical and/or biochemical signs of hyperandrogenism • Ovarian dysfunction (Oligo-anovulation and/or polycystic ovarian morphology) *(Both criteria needed)*

As you can see, if a woman has ovarian dysfunction where they don't ovulate or ovulate very irregularly (Oligo-ovulation – cycles longer than 36 days and less than 8 times a year) *and* they exhibit hyperandrogenism, they will most likely fall into the criteria of having PCOS. Notice that having polycystic ovaries is not a main diagnostic criterion despite the name of the disease. Using these criteria and common clinical observations, it's possible to diagnose by doing a physical exam of a woman and asking: Does she show signs of hyperandrogenism like facial hair, central obesity and acne? Is this happening in combination with an irregular menstrual cycle? This is where the power of clinical diagnostics lies – by taking the time to observe and get to know the client accurate diagnosis can be made, even in the absence of blood testing (Thatcher 2000).

Beyond these commonly used criteria for diagnosing PCOS, women can get a series of blood tests that can provide more insight into hormone levels in the body and also examine the progression of the disease – particularly in regard to Insulin resistance, diabetes and heart disease. None of these tests will determine 100% that a person has PCOS, they may be used just for further investigation.

Test	**What the test shows**
Testosterone – total and free	These tests can check for elevated androgen levels and rule out the possibility of androgen producing tumor.
Luteinizing Hormone/Follicle stimulating hormone	Higher ratio of LH/FSH can be indicative of PCOS, though some women have normal LH levels.
SHBG	Tests ability to bind testosterone. Low SHBG may indicate PCOS and insulin resistance.
Prolactin	Prolactin is a hormone secreted by the pituitary that stimulates lactation. High prolactin can suppress periods. Women with PCOS often have high prolactin. Persistently high prolactin can also be caused by pituitary tumor, so it's good to check this out.

Thyroid Stimulating Hormone	Many women with PCOS have low thyroid function and TSH is a common way to measure thyroid function. High TSH may be indicative of hypothyroid, which can be responsible for weight gain and abnormal menstrual cycles. If tests results for TSH are abnormal, further thyroid testing can be performed to rule out thyroid disease.
Fasting Insulin	This will test insulin in the blood after fasting and can indicate hyperinsulinemia.
Fasting Blood Sugar	This test measures glucose in the blood after 8 hours of not eating. It is taken first thing in the morning and can be used to evaluate insulin resistance or glucose intolerance
Glucose Tolerance Test	If you have abnormal fasting blood sugar, the glucose tolerance test can determine how your body utilizes sugar over time. If sugar is found in the urine during this test, there is evidence of insulin resistance, diabetes, kidney failure or Cushing's syndrome.
Lipid Profile	This tests looks at cholesterol in the blood. Elevated androgens in PCOS may cause abnormal lipid levels and put a person at risk for cardiovascular disease.
Pelvic Ultrasound	This will check to see if there are cysts on the ovaries or if the ovaries are enlarged – which is a sign of PCOS. This can also show the status of the endometrial lining, which may be thickened if a woman isn't having regular periods.

Chart references: (Roush 2010; Thatcher 2010)

As you can see, there are many lab tests that may be performed and while they are not necessary to diagnose PCOS, they may provide peace of mind to the client in their diagnosis and rule out other diseases. These tests are useful in examining the state of the body and help as a way target diet and treatment plans accordingly, particularly if a person is experiencing pre- or full blown diabetes and cardiovascular disease. These secondary conditions associated with PCOS will be examined in the following section.

PART 3: CONDITIONS AND COMPLICATIONS ASSOCIATED WITH PCOS

Beyond the troubling causes and symptoms present in PCOS, there are conditions and complications that can be aggravated by the disorder. The two most important and frequent are Type Two diabetes and Cardiovascular disease – both of which are linked to metabolic syndrome and can be seen in women without PCOS who have a poor diet and unhealthy lifestyle. There is also an increased risk of reproductive cancers, which are linked to hormone imbalance, and an increased incidence of depression and anxiety.

3.1 METABOLIC SYNDROME

Metabolic syndrome is seen in about 40% of women with PCOS (Roush 2010) and may present itself in early childhood, prior to the discovery of PCOS. Metabolic syndrome is a group of metabolic disturbances that cause high blood pressure, high blood sugar, high bad cholesterol and obesity. These four consequences of metabolic syndrome are called the Deadly Quartet (Stansbury 2012). Metabolic syndrome really centers around insulin resistance and the effect of insulin resistance and high blood sugar and lipids on the blood vessels, tissues and organs of the body (Grundy et al. 2005).

3.1.1 Type 2 Diabetes

Insulin resistance and hyperinsulinemia play a profound role in the onset and progression of PCOS. The consequence of high insulin resistance and subsequent hyperinsulinemia is the development of Type 2 diabetes mellitus more commonly referred to as adult onset diabetes. Diabetes is diagnosed by testing positive for elevated blood glucose levels. Roughly 15-20% of women with PCOS will develop diabetes (Stansbury 2012). Diabetes occurs when severe insulin resistance in the body develops overtime, causing blood glucose to remain in the blood rather than being absorbed into the cells to be used for energy. There are many health complications associated with diabetes as high sugar and fats in the blood can damage cells, nerves, tissues and organs as the disease progresses (Thatcher 2000).

Having the excess blood fats and sugars that come with diabetes can lead to inflammation and oxidizing processes throughout the circulatory system. Inflammation

and oxidation can damage the blood vessels causing them to become less elastic, which can cause blood pressure to increase and lead to increased risk of heart attack, stroke and other vascular diseases (NIDDK 2013). This is addressed in the following section.

Diabetes can cause increased risk of infections because the high sugar in the body creates an environment that is hospitable to bacteria, viruses and fungi. We see that these infections may be frequent colds or flus or they can be bladder and skin infections. There may also be chronic candida issues in diabetic people or the fungus may be on the skin (Stansbury 2012).

Diabetes can also lead to retinopathy, where the retina is damaged due to fats and sugars in the blood that get into the tiny vessels that service the retina. If diabetes is left untreated, this can lead to blindness. Typically, treatment for this retinopathy is based on protecting the tiny blood vessels that service the eyes using things like ginkgo, garlic and blueberries (NEI 2012).

10-40% of people with type two diabetes will acquire kidney disease due to the damage sugar causes to the tiny blood vessels and nephrons in the organ (National Kidney Foundation 2015). Many diabetics who have kidney disease will develop kidney failure and have to go on dialysis to have their blood cleaned since the kidneys are no longer functional. Kidney failure is a disorder that eventually is fatal.

Diabetics often lose parts of their extremities due to non-healing ulcers, this process is called cutaneous ulceration. This happens when the tiny blood vessels that support microcirculation are damaged and oxygen isn't getting to the extremities. Often times, where blood vessels are damaged, a wound will develop and it will not heal. These can eventually get infected and gangrene and amputation may be necessary (American Diabetes Association 2014).

About 50% of people with diabetes will also develop neuropathy or peripheral tingling and numbness. This is a sign of nerve damage and can be aggravating to painful but can also cause people with diabetes to not feel nerve sensations that they need to in order to remain healthy (Stansbury 2012). For example, if you can't feel your foot, you might injure it and not know and develop and ulcer that won't heal. In a more extreme case, you might not feel heart pain that is indicating a heart attack. There are medications to treat neuropathy but some have significant side effects.

The extent to which diabetes affects the entire body and all of its organs is mind-boggling. It is very important to take control of diabetes development as early as possible to avoid as much damage as possible.

3.1.2 Cardiovascular disease

As you can see from above, diabetes greatly increases the risk of cardiovascular diseases. If fact, people with type two diabetes are at a 100 to 200 percent greater risk of dying from cardiovascular disease than those with out diabetes (Feinberg 2004). People with diabetes are at risk for two major types of cardiovascular disease; first, coronary artery disease and secondly, cerebral vascular disease. People with diabetes are also at risk for heart failure and peripheral arterial diseases (NIDDK 2013).

Coronary artery disease is causes by thickening and hardening of the walls of the blood vessels that run to and from your heart. When these vessels get narrowed and blocked by fatty plaque deposits, blood flow to the heart is reduced or eliminated and will result in a heart attack.

Cerebral vascular disease is when blood to the brain is cut off. This usually happens when a blood vessel in the neck is narrowed or blocked due to hardening of the blood vessels to the brain. This can result in a stroke.

Both coronary artery disease and cerebral vascular disease are seen in people with metabolic syndrome and type-two diabetes due to the damaged caused by high sugar and bad fats in the blood, which damage the blood vessels, causing them to harden. Narrowed, inelastic blood vessels cause blood pressure to rise and further damage the vessels and increase risk of a devastating heart attack or stroke.

Diabetes can cause heart failure because high blood glucose can damage the heart muscle itself (cardiomyopathy), causing the heart muscle to be less effective. Heart failure is not as immediate of a disease as it sounds, rather it is the progressive worsening of the hearts ability to pump blood properly. Heart failure develops slowly and gets worse over time. Typically, a person with heart failure will have fluid build up in the extremities and sometimes the lungs because the heart is having trouble pumping fluids back up from the extremities resulting in edema. Heart failure is typically treated with diuretics as a way to get fluid out of the system – it by no way treats the heart disease itself. Besides

edema, other symptoms of heart failure include shortness of breath, extreme fatigue, and weakness. Edema caused by heart failure can create and exacerbate cutaneous ulceration because the skin becomes thin and damp and infection is more prone to happen (NIDDK 2013).

Peripheral arterial disease was discussed in the previous section in regards to poor circulation in the legs and feet, which lead to amputations.

3.2 REPRODUCTIVE CANCERS

The long-term hormonal imbalances and excessive stimulation of hormonal tissues seen in women with PCOS greatly increases the risk of developing reproductive cancers. Women with PCOS are two to three times more likely to develop ovarian and endometrial cancers than those without (Stansbury 2012). As an example, women with PCOS who never or rarely have a menstrual flow are in a constant exposure to estrogen and have a thickening of the endometrial lining because isn't shed regularly. This thickening is called endometrial hyperplasia and over time, cells in the lining can change and become abnormal and even cancerous. The fewer periods a woman has, the higher risk she is for endometrial hyperplasia (Roush 2010). This really emphasizes the importance of balancing hormones to bring on a more normal menstrual flow as a means of reducing cancer risk.

3.3 DEPRESSION AND ANXIETY

As you can imagine, having PCOS and all that goes along with it can be very stressful, upsetting and possibly depressing to those who suffer from it. Having to face the often judgmental world as a person who, often at no fault of their own, is obese with acne and facial hair may be very difficult. Beyond one's outward appearance, infertility for women who desire to have children is upsetting to say the least. In this sense, it becomes important to educate and empower women to take charge of their own health. To some, this may involve taking anti-depressants or anti-anxiety medication, while for others in may mean working with herbs to boost one's mood or working with a therapist

or other healer (Roush 2010). This is really case-by-case and may not hold true for all women with PCOS but it is a very important factor to consider.

PART 4: MANAGING PCOS

As you can see, PCOS is a very complex disorder involving many processes and imbalances. The good news is that regardless of how PCOS manifests itself in a woman, treatment options are available and can be somewhat universal across PCOS phenotypes. Diet and exercise as a means to lose weight and decrease blood sugar and fasting insulin is the most straightforward way to bring hormones into balance and hopefully restore a more normal menstrual cycle. There are however supplements, allopathic and herbal medicines that are used to treat symptoms of PCOS. Listed below are management strategies for PCOS with the hope that symptoms/complications such as infertility, diabetes, obesity, cardiovascular disease and other hindrances can be mitigated.

4.1 DIETARY THERAPY

For women with PCOS, it is very important to restore balance across all metabolic and reproductive functions. Dietary changes are the most effective strategy in restoring this balance because it can greatly reduce fasting insulin – which is the most significant contributor to the severity of the disease (Douglas et al 2006). It has been shown that a woman with PCOS can lose just 5-10% of body mass and increase fertility, reestablish menstrual cycles, and begin to bring hormonal and metabolic processes into a more normal rhythm (Thatcher 2000). Dietary therapy for women with PCOS focuses on eliminating foods that increase blood glucose and bringing in foods that help stabilize blood sugar, help with insulin resistance and provide therapeutic effects. In the following dietary plan, in addition to changing food choices, women should eat more small meals throughout the day as opposed to few larger meals. This helps balance blood sugar, letting your body metabolize sugar and carbohydrates more efficiently.

Below are a couple of charts outlining dietary changes for managing PCOS. This is based off of Jillian Stansbury, ND protocol (2012).

A Healthy diet for women with PCOS should include:	**Why? How?**
High Complex carbohydrate Foods	Complex carbohydrates are carbohydrates that take longer to break down into sugar and occur naturally in whole fruits, vegetables, legumes and grains. Of these complex carbs, whole grains provide fiber and B-vitamins, Vitamin E and trace minerals. Fruits provide fiber, antioxidants, and nutrients, simple and complex sugars. Legumes are high in protein, fiber, macronutrients and pinitol. Pinitol helps with insulin resistance. Eating complex carbohydrates provides the body an array of vitamins, minerals and other nutrients to help meet dietary needs.
Foods low on the glycemic index	The glycemic index is a measure of how fast the body will break foods down into sugars. Foods higher on the glycemic index will cause blood sugar spikes. However, foods should not be chosen based on glycemic index alone, as sometimes it could be deceiving.
Whole Foods	Whole foods are unprocessed foods and eating them keeps people from filling up on junk, processed foods. Whole foods contain all of the fiber, fats, vitamins and minerals together in one balance package. Whole foods include whole grains (not whole grain bread), fruits, vegetables, meats, fish, seaweeds and spices. 75% of the diet should be whole foods. Good whole grains to eat include quinoa, barley, amaranth, brown rice, corn, whole wheat, rye, wild rice and buckwheat. When these grains are used, its important to get grains fresh and if they are milled to keep them refrigerated.

High-fiber foods	Eating fiber helps slow the release of sugar into the blood stream, which helps balance blood sugar. For example, if you have apple juice, the fiber is extracted and blood sugar may spike, but if you eat a whole apple, the sugar spike will be slower and lower. In addition to fiber occurring naturally in foods, you can get fiber from freshly ground flax seed, psyllium husk and chia seeds.
High-protein foods	Proteins are very important in the PCOS diet. They do not cause a spike in blood sugar and help keep one satiated for longer, reducing snacking. It's good to eat protein with every meal on this plan. When selecting protein, its good to eat lean meats and to prepare meat in a way that doesn't make the fat become rancid – as can happen when frying meats. Poached fish and eggs contain a lot of great nutrients and fats in addition to protein. Legumes, as mentioned above are a great source of protein and can easily be added to many meals.
Foods high in essential fatty acids	Fatty acids have been shown to prevent some diseases and are important for a variety of metabolic functions throughout the body. There are two types of unsaturated fatty acids that are good to add into the diet. First, monounsaturated fatty acid, which can raise HLD – good cholesterol. These fats have shown to increase insulin sensitivity. Monounsaturated fatty acids are found in olive and canola oil, avocados, cashew, peanuts and sesame seeds. Polyunsaturated fatty acids include omega 3 and omega 6 essential fatty acids. These are considered essential because our body cannot synthesize these on our own but they are important for metabolic functions. Omega-3's are broken down into three categories: alpha-linoleic acid (ALA), eicosapentanoic acid (EPA) and

	docosahexaenoic acid (DHA). ALA is found in plants like flax seeds, canola, walnuts, and chia seeds. EPA is found to reduce risk of heart disease and is found most commonly in fatty, cold-water fish like salmon, trout, tuna, sardines, mackerel and can often be taken in fish oil capsules. DHA is the most commonly found fatty acid used in the brain and can be found in fatty fish like the ones listed above. Omega 3's have been shown to prevent neurological degeneration like Alzheimer's, Parkinson's and has even been sued to treat mental disorder like ADHD and bipolar disorder. Making sure you get good quality omega 3's into the diet it very important. Omega 6 fatty acids are precursors to inflammation and need to be balanced by omega-3's. This balance is often disrupted because omega 6's are very commonly used in processed foods in the form of corn, canola and soy oils. One omega-6, linoleic acid is important in the prevention of heart disease and can be found in olive, sesame, sunflower and walnut oil and in many nuts. It can also be found in borage oil, evening primrose oil, and currant oil. It is good to incorporate GOOD QUALITY oils into the diet in order to get the benefits. Oils should be cold-pressed, raw, and not heat-treated to avoid rancidity.
	There are certain foods that work really well on bringing a person with PCOS back into metabolic and hormonal balance. These foods include flaxseed (which should be ground just prior to using to avoid rancidity). Flax seeds can replace some

Therapeutic/super foods	amount of flour and eggs in baking. Legumes are a super food for PCOS because they contain high amounts of pinitol and D-chiro-inositol, which help with insulin resistance and hormone balance. Sprouted grains are great for this dietary protocol as they make amino acids more bioavailable to the body. They also contain higher levels of vitamins and minerals include the b-complex. Maca powder can be used to lower blood sugar and balance hormones. It can be added to many foods and smoothies. Nuts are also a super food for PCOS, they are good sources of protein and nutrients for snacking, baking or for making nut milks with.

Foods that should be avoided in PCOS:	**Why? How?**
Refined carbohydrates	Refined carbohydrates, unlike complex carbohydrates provide high amounts of sugar without the fiber and vitamins and minerals. Typically these will cause blood sugar spikes and exacerbates insulin sensitivity.
Highly Processed Foods	Processed foods contain poor quality fats, sugars and many artificial colors and flavors that are not good for anyone.
Trans fats	Include hydrogenated vegetable oils, commonly found in processed foods and in margarine. These fats are manufactured and raise LDL and lower HDL. This increases inflammation and risk of cardiovascular disease.
	Avoiding produce that is not grown organically, if

Non-organic produce and meats that might have glyphosate on them.	possible, is really the best choice. Conventional produce may have pesticide residues, including the terrible glyphosate. Organic fruits have shown to have more nutrients in them as well. Meats that are not raised organically may also have high levels of glyphosate residues in them due to their commonly used round up ready feed. Non-organic meats are also treated with antibiotics and lots of growth hormones, which for many reasons is not wise to ingest.

While the guidelines listed above are fairly simple, it is much harder to actually commit to a dietary plan in practice. However, because changing diet in PCOS can have such effective results in easing symptoms, helping with weight loss, and decreasing risk of severe complications like diabetes and cancer, there is great incentive to stick with the plan.

One way to help follow these guidelines is to do some meal planning – there are still so many ingredients that you can cook with. It's helpful to plan out meals and make sure all of the ingredients are at home and ready to be used. This will eliminate the need to go out and grab a quick, unhealthy snack elsewhere. Overtime, the sugar cravings will subside, as will the symptoms of PCOS.

4.2 SUPPLAMENTS

Vitamin D: Vitamin D is a vitamin our body makes from sunshine. People are becoming more deficient in Vitamin D they use sunblock and spend less time outside and therefore it is important for most people to supplement vitamin D using food sources or capsules. Vitamin D deficiency is linked to insulin resistance and diabetes. Vitamin D helps Support the absorption of calcium and phosphorus and is an immunomodulator (Thatcher 2000). Vitamin D helps increase insulin sensitivity and blood sugar metabolism – making

it very useful in diabetes and PCOS (Stansbury 2012). Vitamin D is found in some foods but not in sufficient amounts is most readily available by taking Vitamin D3 capsules.

Chromium: Chromium can help transport the message of insulin from outside the cell to inside the cell and can be beneficial to glucose metabolism. Chromium also supports serotonin in the brain and helps metabolize cholesterol and nucleic acids (Stansbury 2012). It is also an antioxidant. Chromium should be taken in microgram amounts (Thatcher 2000)– no more than 200 per day and should maybe even be supplemented through a multivitamin or foods like hibiscus flowers and brewers yeast.

N-Acetyl cysteine (NAC): NAC is a compound that comes from the amino acid L-cysteine (also found in eggs). NAC protects the liver against environmental toxins and ingested chemicals. NAC is very commonly used to dissolve mucus in people with COPD and other respiratory diseases. In PCOS, NAC has been shown to improve insulin sensitivity in about five weeks (Stansbury 2012). NAC has also helped improve fertility rates, which is probably linked to decreased insulin sensitivity. 600mg capsules of NAC once per day is a common dosage.

Inositol: Insulin resistance may involve faulty signaling between the interior and exterior of the cell in its acceptance of insulin. Inositol-containing phosphoglycan molecules are involved in this signaling process. Using different forms of inositol may increase insulin sensitivity and so it is a great supplement for women with PCOS who have insulin resistance. Inositol can be found in the form of pinitol, which is found naturally in legumes and buckwheat. D-chiro-inositol is a type of inositol that has shown the ability to aid in treating metabolic syndrome by decreasing triglycerides, lowering blood pressure (Stansbury 2012). D-chiro-inositol is a supplement that can provide this action as well (Thatcher 2000). Lecithin is also very rich in D-chiro-inositol and can be used in the form of soy lecithin (organic) and added to smoothies and other foods.

Fish Oil Capsules: Fish oils, as mentioned above, provide omega-3 fatty acids, which are essential nutrient that the body needs to make energy and prevent degenerative

diseases. Fish oils can also bring good cholesterol up, helping fight against cardiovascular disease.

B-Vitamins: B-vitamins play an important role in so many chemical reactions in the body – including hormone regulation, fat and sugar metabolism, and other functions that help the body maintain homeostasis. A sublingual b-complex is a great way to take them.

Antioxidants: Vitamin A, C, E. Selenium and Zinc are all important antioxidants that have a variety of functions. These will all help with the oxidative stress that comes with chronic inflammation and high blood sugar and metabolic syndrome. Many of these antioxidants can come from eating a bright rainbow full of fruits and vegetables – particularly high in antioxidants are berries.

Magnesium: Magnesium is a very important vitamin for many cellular and neurological functions in the body. Low levels of magnesium have been associated with atherosclerosis and diabetes. Most people in the world, particularly those afflicted with a chronic disease would be wise to take between 200-400 mg magnesium per day (Thatcher 2000).

4.3 EXERCISE

Exercise is very important for everyone, but especially for people with PCOS and metabolic syndrome. These people have to eat better and exercise more than the average person to maintain a healthy weight. By adapting the diet to the guidelines above and working exercise into the daily regime, weight loss will happen and hormone and metabolism will become more in balance. Exercise will strengthen the lung and the heart and all of the muscles, and when muscles get worked out, they will help burn fat.

Create an exercise routine that is enjoyable to you, whatever that is. Start off slow, maybe just exercise and get your heart pumping 10 minutes a day and increase that each week. I find that waking up and taking a walk each morning before breakfast helps get my blood flowing, keeps my head clear and is a really good way to start the day. It

also gets “the dreaded” exercise out of the way early so you don’t feel guilt or anxiety about getting exercise. Once an exercise routine is established, it will get easier and more invigorating. This will also help with peripheral circulation and burn calories so you can lose weight.

4.4 ALLOPATHIC MEDICINE

There are several pharmaceutical medications that are used to treat the symptoms and diseases associated with PCOS. These drugs are most commonly used for fertility, menstrual cycle regulation and diabetes.

4.4.1 Insulin-Sensitizing Agents

Insulin-sensitizing medication are some of the most commonly prescribed medication for women with PCOS who have some degree of insulin resistance and/or diabetes. These drugs often fall into the category of Biguanide medications and are traditionally used for the treatment of type two diabetes – as it increases the sensitivity of cells to insulin so that glucose can be used more effectively (Stansbury 2012).

The most commonly used biguanide in the treatment of type two diabetes and PCOS is **Metformin** (Mathur et al 2008). Metformin increases insulin sensitivity while also decreasing glucose production in the liver. Metformin has been used to treat diabetes since 1995 and has shown great promise in reducing insulin resistance, stimulating weight loss, and reestablishing a normal menstrual cycle in women with PCOS (Thatcher 2000). For woman at particularly high risk of developing type 2 diabetes, Metformin may be a great option.

Metformin has also shown promise in increasing fertility among women with PCOS by increasing ovulation rates. Metformin may not be the fastest route to fertility with PCOS but if a woman wants to get pregnant within a few years, it is a good option. Metformin is often taken with Clomid to induce ovulation. Metformin may also reduce gestational diabetes and incidence of miscarriage, though more research in this field is necessary (Mathur et al 2008).

Metformin does come with some side effects and risk. For starters, it should not be used by anyone with kidney disease or impairment because it may cause lactic acidosis (Inzucchi et al 2014). Metformin can cause abdominal cramping, diarrhea, discomfort and nausea in about 25% of women (Roush 2010). It's best to consult with a physician to discuss side effects and contraindications before taking metformin. It is also a good idea to regularly get blood test to screen for changes in insulin and kidney function when taking this medication.

4.4.2 Fertility Treatments

PCOS is the most common cause of infertility among women in the United States, and many women may not realize they have PCOS until they are trying to get pregnant. Often times, women with PCOS go see allopathic doctors and fertility specialists to help them achieve pregnancy. There are a few routes women with PCOS often take to achieve ovulation and pregnancy and they are listed below. All of these come with risks and side effects and its up to the individual seeking out these treatments to assess the risks and benefits of using allopathic fertility treatments.

Clomid: Most commonly, women are given Clomiphene Citrate (Clomid) to induce ovulation. Clomid has been used since 1967 and has succeeding in inducing ovulation in 80% of women who take it, though about half of these women actually conceive (Roush 2010). Clomid is a good first choice because it is fairly inexpensive and effective. Clomid doesn't work as well in women over 35 or who are obese – which is why it is commonly combined with Metformin (See Below). There may be other risks involved if it is used too frequently or for long periods of time.

Gonadotropins: Gonadotropins involved in the menstrual cycle are FSH and LH, which have been discussed at length already. There are several injectable products on the market used to induce ovulation that are typically derived of synthetic FSH and LH. This method involves using injections to get the follicle to mature and when it does taking another injection that will cause the egg to pop-off. At this time, you have intercourse and hopefully get pregnant (Roush 2010). The risk of this method is the increased chance of

having multiples (twins, triplets, etc.). Working closely with a fertility specialist is very important when using this therapy.

In-Vitro Fertilization: In-vitro fertilization is when an egg is removed from the ovary and fertilized in a petri dish and the embryo is then reinserted back into the uterus. This method can be upwards of $20k and has a success rate of about 35%. Multiple births are also fairly common in this scenario because there are often multiple embryos implanted to increase chances of pregnancy (Thatcher 2000).

4.4.3 Birth Control Pills

Birth controls are made of low-doses of synthetic estrogen and progesterone. Birth control pills are very commonly used to help women with PCOS menstruate. This allows for monthly periods so the uterine lining can be shed and doesn't build up. Regular shedding of the endometrial lining may help prevent endometrial cancers. (Stansbury 2012). Keep in mind that just because menstruation is induced, this does not mean ovulation is happening. Having a monthly cycle also allows a woman to know if she is pregnant or not (Boss et al 2009). Birth control pills can also normalize hormones in the body so that excessive hair growth and acne may be mitigated to some extent. Synthetic hormones and have side effects associated with them. When taking synthetic hormones of any type, it is important to support the liver as it takes on the tough job of metabolizing the hormones.

4.4.4 Acne Treatments.

As mentioned above, birth control pills can be used to help treat acne by bringing hormones into a more balanced state(Roush 2009). Some other pharmaceuticals used to treat acne are antibiotics like tetracycline. Using antibiotics may help some women with acne, however, antibiotics have a while range of undesirable side effects – particularly the decimation of beneficial gut microbes. Another medication used for acne is called Accutane. This medicine decreases the amount of oil being produced by the sebaceous glands (Boss et al 2009). Accutane is very strong and has presented some very devastating side effects including suicidal thoughts. All pharmaceuticals used in the

treatment of acne should be carefully considered and weighed against using other methods to balance the hormones to get at the root cause of the acne.

4.4.5 Ovarian drilling

Ovarian drilling is a surgical procedure used to promote ovulation. This is an outpatient surgery where a laser is used to pierce the cysts on the ovaries and drain the fluid from them. By removing many cysts, androgen levels are reduced, allowing for more normal hormones to promote ovulation. About 80% of women who get ovarian drilling will ovulate but only 30-40% of these women will get pregnant (Boss et al 2009). This procedure can be painful and also carries the risk of any surgery including infection and bleeding.

4.5 HERBAL PROTOCOL

Herbal medicine can be very beneficial in managing symptoms of PCOS and creating a healthier and happier life for these women. Often times, herbal medicine is safer than allopathic medicine when addressing chronic health disorders as a good formula works on the root cause of disorder rather than suppressing symptoms alone. However, herbal medicine can also be used as complementary protocol along with allopathic treatment if that is what the patient decides to do.

In this section, I outline what goals we want to achieve when using herb in PCOS and create a sample treatment plan. A short materia medica is also provided to show the wealth of herbs that can treat PCOS symptomology.

4.5.1 Goal Setting

When selecting herbs to manage the symptoms of PCOS, goal setting is a good place to start. For women with PCOS, the primary goals of herbal therapy are:

(1) Decreasing excess androgens and balance hormones
(2) Stabilize and lower blood glucose levels and reduce insulin resistance
(3) Increase circulation and assist in lipid management in the body in order to protect the cardiovascular system

Secondary goals:

(1) Decrease inflammation
(2) Support the liver
(3) Support the body to combat against stress
(4) Support the thyroid
(5) Support the immune system
(6) Provide minerals and nutrients that help the body achieve metabolic and reproductive homeostasis

Herbal actions needed to support these goals:
Hormonal normalizer, circulatory stimulant, anti-inflammatory, cardioprotectant/tonic, blood sugar stabilizer, hepatic, alterative, adaptogen, lymphatic and immunomodulator.

4.5.2 Sample Treatment Plan: Treatment plans will vary based on the client's constitution, presentation of the disorder and other factors. This is a sample treatment plan that aims to achieve the aforementioned goals. These herbal formulas should be used in addition to dietary therapy and exercise.

Main formula - Tincture- Dose: Two droppers full four times a day.

Herb	Part	**Action**
*Vitex berries (*Vitex angus-castus) and/or* Dong Quai (*Angelica sinensis)*	13	Vitex: Hormonal Normalizer, uterine tonic, acts on the pituitary. Dong quai can normalize hormones, clear stagnation from the uterus by promoting blood flow to the pelvis.
Astragalus (*Astragalis membranaceus)* and Turmeric (*Curcuma longa*) roots	8	Immunomodulating, anti-inflammatory, protects tissue from inflammation caused by high glucose, enhances insulin sensitivity, anti-cancer, hepatoprotective, adaptogen, cardioprotective, builds wei qi. Hepatic. Anti-cancer.
Oregon Grape Root (*Mahonia*	5	Hepatic by helping liver metabolize fats and

aquifolium)		process hormones, anti-inflammatory, reduces insulin resistance, alterative, cholagogue, laxative, helps with chronic skin conditions (as a result of its liver action), anti-bacterial, anti-fungal.
Saw Palmetto berries (*Serenoa repens*)	3	Decreases androgen uptake, serum testosterone levels and the conversion to androgens to DHT, which causes some of the unwanted hirsutism, hormonal normalizer, anti-inflammatory, diuretic, urinary anti-septic, nutritive tonic.
Linden flowers (*Tilia cordata*)	2	Hypotensive, cardiac tonic, anti-inflammatory, antidepressant, nervine relaxant, astringent.
**Licorice root (*Glycyrrhiza glabra*)	1	Improves insulin resistance, helps resolve metabolic syndrome, anti-inflammatory, hepatoprotective, anti-spasmodic, demulcent, expectorant, immunomodulator, formula harmonizer, adaptogen.
Cinnamon bark (*Cinnamomum spp.*)	1	Stabilizes blood sugar, demulcent, astringent, warming, carminative.

Notes: *Vitex may or may not be desired depending on the hormone balance the client is presenting. For many women with PCOS, Vitex is a vital part of their formula but it isn't a universal remedy for hormone imbalance as it is often touted. It increases LH, which is often high in women and can decrease estrogen and prolactin. Getting hormone blood tests prior to formulating may help determine if Vitex should be included in the formula. Vitex may be added to the formula after it has been in use for some time if it seems like it would help. The dietary protocol leading to weight loss is also hormone balancing. Dong Quai may be used in women with low estrogen – which can be the case in PCOS. It may be used alone or with Vitex.

**Licorice should not be used to a great extent in people with high blood pressure. If a person has high blood pressure, it should be monitored on a regular basis by a physician.

Herb Shake- to be used to flavor foods throughout the day. This herb combination should be pre-mixed, yet not ground until just prior to using. Parts can be blended by client to particular taste. Other aromatics can be added as desired by the client. Brewers yeast may also be added for additional nutrients.

Herb	**Action**
Flax seed	Contains essential fatty acids (see dietary section)
Milk Thistle Seed	Hepatic, hormonal and metabolic normalizer
Fenugreek Seed	Traditionally used in the treatment of diabetes to lower blood glucose
Sesame Seed	Rich in nutrients and good anti-inflammatory oils.
Dried Garlic and Dried Onion	Supports healthy cardiovascular function and circulation. Lowers bad cholesterol, increases circulation
Alfalfa	Enhances glucose metabolism and hormonal balance. Contains many minerals.
Rosemary	Circulatory stimulant, aromatic, carminative, digestive, anti-microbial, anti-spasmodic, emmenogogue, diuretic, nervine stimulant.
Seaweed – like bladderwrack	Contains high amounts of trace minerals and iodine and will help with the uptake of good iodine in the thyroid (versus radioactive iodine). Known to help hypothyroidism.
Sea Salt or other mineral rich salt – can be smoked if desired.	Contains many trace minerals and makes food taste good!

Anxiety Formula: This formula should be used as needed by the client if they suffer anxiety, particularly in social situations. A little of this formula can lift the mood and ease anxiety. Client can experiment with dosage that works for them – start small and increase as needed. This should not be used if the client is taking pharmaceuticals that it may interact with, particularly anti-depressants or anti-anxiety medications.

Herb	Part	Action
Kava	2	Relaxing nervine, anti-spasmodic, hypnotic in large doses
Lemon Balm	1	Anti-depressant, nervine relaxant, carminative, hepatic.
St. John's Wort	1	Anti-depressant. Liquid sunshine.

Refreshing Herbal Drink: Tulsi, Hibiscus, Prickly pear juice, calendula, ginger and stevia.

4.5.3 Other Herbs Useful in PCOS Management:

Listed below are herbs that are helpful in the management of PCOS. All of these herbs work in various capacities for women with PCOS and should be used appropriately in formulation.

Herbal Actions	Herbs
Hormonal Normalizers/Influencers	White peony, Dong Quai, Black Cohosh, Tribulus
Circulatory Stimulants	Rosemary, Cayenne, Ginkgo, Dong Quai, Fresh Ginger
Anti-inflammatory	Turmeric, licorice, ginger, reishi
Hepatic	Burdock, Dandelion root, Schisandra, milk

	thistle
Adaptogens	Schisandra, Tulsi, Astragalus, Maitake, Reishi, Gojo berry, ashwaganda
Cardioprotective/tonic	Hawthorn, Tilia
Blood sugar stabilizers	Guggul, Gymnema sylvestre, Cinnamon, American and Asian ginseng, Amla, cordyceps, dang shen, eleuthero, guduchi, fo-ti. Licorice, holy basil.
Alterative/Lymphatics	Poke, Red Root, Calendula, Red Clover, Cleavers
Anti-depressant/anxiety	Lemon Balm, Motherwort, Passionflower, milky oats, skullcap, Tilia
Uterine Tonic	Raspberry Leaf, Dong Quai, Shepard's Purse

CONCLUSION:

As you can see from this report, PCOS is an extremely common disorder, with a very complex pathophysiology that has serious health implications for those who suffer from it. As an herbalist, it is very important that we know how to identify treat this syndrome using diet, exercise and herbs. It is also necessary to learn how to work with allopathic medicine to support a woman's choice in how she wants to treat her own PCOS. Often times, taking some pharmaceuticals is the best option for a woman to avoid diabetes and achieve pregnancy. Working with various management techniques, one needs to be flexible in mind and in practice in order to shift and adapt as the syndrome and woman changes. It is also crucial to understand that PCOS is absolutely not the fault of the woman who has it – it is genetic and environmental and all too often is not viewed as such Releasing a woman from the shame that is often associated with this disorder is important to begin the healing process and return the body to a state of resiliency and balance.

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