Vitamin D and Cancer

0. Prevention and Treatment
0. Breast Cancer
0. Colon Cancer
0. Prostate Cancer

Articles about vitamin D are beginning to appear everywhere. For years, most of us wrongly assumed we'd be fine if we drank a little milk and took a multivitamin pill. Now, studies are reporting most of us are vitamin D deficient and those deficiencies may well be causing numerous illnesses, especially cancer.

Recent medical research indicates humans may need up to ten times more vitamin D than is currently recommended. Study after study shows many of us are not only vitamin D deficient, we may be paying a terrible price for it.

Benefits of proper vitamin D supplementation seem to include most major illnesses, not just cancer. Heart disease, hypertension, arthritis, chronic pain, depression, hypertension, inflammatory bowel disease, obesity, premenstrual syndrome, muscle weakness, fibromyalgia, Crohns disease, multiple sclerosis, and various other autoimmune are also implicated by recent research.

This web site is dedicated to vitamin D and cancer because exciting new studies indicate vitamin D from ultraviolet radiation (available from the sun or sun lamps) or from cholecalciferol capsules (available at any health food store or over the Internet) may help cancer patients. However, the research is far from complete. As we will say repeatedly, although vitamin D may help, it should only be taken in addition to standard cancer treatment; it is never the first or only treatment. Oncologists work miracles every day.

Also, please remember that vitamin D may be toxic in overdose although one expert recently said, "worrying about vitamin D toxicity is like worrying about drowning when you are dying of thirst." That said, many people think that if a little is good then a lot is better. This is definitely not true about vitamin D. The only way to know if vitamin D might help your cancer is to either read the current scientific literature for yourself or read our summations on this web site and then decide for yourself.

The Vitamin D Council sponsors this web site. We are a non-profit, tax-

exempt organization dedicated to educating consumers and professionals about the epidemic of vitamin D deficiency. We are not your doctors and will not make any medical recommendations concerning vitamin D supplementation. We are in the process of writing an e-book discussing supplementation options for cancer patients. Therefore, in the near future, we hope to be able to tell you what we think we would do if we developed cancer.

Prevention and Treatment

To easily read about vitamin D and cancer, you need to memorize three words. These three words are **cholecalciferol**, **calcidiol** and **calcitriol**.

. **Cholecalciferol** is the naturally occurring form of vitamin D. It is sometimes called vitamin D_3. It is the substance made in large quantities in your skin when sunlight strikes your bare skin. It can also be taken as a supplement. Cholecalciferol is vitamin D. All other compounds are either metabolic products or chemical modifications.

. **Calcidiol [25(OH)D]** is a prehormone in your blood that is directly made from cholecalciferol. When being tested for vitamin D deficiency, calcidiol is the only blood test that should be drawn. When someone refers to vitamin D blood levels, they are usually referring to calcidiol levels. Your doctor can order calcidiol levels but both your doctor and the lab will know the calcidiol blood test as 25-hydroxy-vitamin D.

0. **Calcitriol [1,25(OH)D]** is made from calcidiol in the kidneys and in tissues and is the most potent steroid hormone derived from cholecalciferol. In fact, it is the most potent steroid hormone in the human body. It is sometimes referred to as the active form of vitamin D. Calcitriol levels should never be used to determine if you are deficient in vitamin D.

The earliest modern connection to cancer and vitamin D was an interesting observation in the 1930s. People who spent years and years in the sun (and subsequently developed a relatively benign form of skin cancer called squamous cell skin cancer), were less likely to develop more deadly internal cancers, such as colon, breast and prostate cancer. This led to one of the first modern theories of cancer, namely that squamous cell skin cancer conferred immunity against more deadly forms of cancer.

The immunization theory turned out to be false but the observation that associated more skin cancers with less internal cancers held. How could the sun cause non-melanoma skin cancers (which kill about 1,500 Americans a year) but prevent more serious cancers (which kill hundreds of thousands of Americans every year)?

In the late 1980s, the two Garland brothers, now epidemiologists at the University of California at San Diego, discovered the answer. First, they discovered that sunlight reduced your risk of colon cancer. Next, the Garlands discovered that women exposed to sunlight were one-half as likely to die from breast cancer as were women who spent less time in the sun. A researcher named Gary Schwartz discovered the same thing about prostate cancer. Both groups of researchers thought vitamin D was the likely explanation.

Then, the Garlands discovered that low calcidiol levels were strongly correlated with developing colon cancer. That would explain the earlier observation that squamous cell skin cancer lowered one's risk of serious internal cancers. Those who developed skin cancer had spent a lot of time in the sun and thus developed both squamous cell skin cancer and high calcidiol blood levels.

Research scientists in the 1980's had already discovered that calcitriol had profound anti-cancer effects, both in the test tube and in animals. It not only reduced the unregulated growth of cancer cells by promoting normal cell death (apoptosis); vitamin D prevented new cells from becoming cancerous (promoted differentiation). It even helped prevent cancer cells from spreading (metastasis) and inhibited cancer cells from developing new blood supply (angiogenesis). In short, calcitriol seemed like the perfect anticancer drug.

However, for many years scientists believed only one form of vitamin D, calcitriol, was important in cancer. As calcitriol is the most active form of vitamin D, the scientists just assumed it was the only form to study. They seemed to be unaware that the Garland's discoveries implied that calcidiol, the storage from of vitamin D in the body, was also important in cancer.

Somewhere along the line, the vitamin D and cancer story took a tragic twist. As vitamin D could not be patented, it held little interest for the medical industry. Plain vitamin D held no promise for financial gain for drug companies or for the researchers who are often financially involved in such companies. Therefore, the medical industry seemed to ignore the evidence that simple vitamin D helped prevent cancer and that adequate vitamin D nutrition may help retard the growth of cancer.

Nor did the cancer scientists seem realize that vitamin D takes at least two pathways in the body. One path, called the endocrine function, produces calcitriol in the kidney to help maintain blood calcium levels. The second

pathway, called the autocrine (inside the cell) and the paracrine (around the cell) functions of vitamin D, produces calcitriol in the tissues. The tissue pathway is more important than the endocrine function as far as cancer is concerned. Scientists failed to realize that the easiest way to raise tissue calcitriol levels is to raise blood calcidiol levels. Furthermore, the easiest way to raise blood calcidiol levels is to go into the sun, use a sunlamp, or take the correct amount of vitamin D by mouth.

Instead, the medical industry turned their attention to developing chemical modifications of the most active form of vitamin D, calcitriol. Called vitamin D analogs, these drugs held the promise for a tremendous profit if studies showed they were active against cancer. Although good reasons existed to support clinical trials with plain vitamin D in cancer patients, the medical industry concentrated on developing vitamin D analogs instead. To date, more than 2000 such analogs have been developed and some have been tested on cancer patients. The results have been disappointing because the drugs cause high blood calcium via the endocrine function of vitamin D. Again, the scientists didn't seem to know that the best way to raise tissue calcitriol is the raise blood calcidiol. Furthermore, the easiest way to raise blood calcidiol levels is to go into the sun, use a sunlamp, or take the correct amount of vitamin D by mouth.

The possibility that such analogs may help cancer patients should not be discounted. However, development of the analogs bypassed a crucial medical and ethical question, which is "Does plain vitamin D help cancer patients?" No one knows because the question has never been studied! In spite of the evidence that vitamin D should help cancer patients, no one has ever given simple vitamin D to cancer patients. Instead, the medical industry formed numerous companies to exploit the potential anti-cancer properties of vitamin D analogs.

Now, let's take a closer look at how the vitamin D analogs are studied because those studies raise important scientific, ethical and legal questions. Analog researchers, who often own stock in the company developing the analog, select two groups of patients, a control group and a treatment group. However, neither group is tested or treated for vitamin D deficiency. In fact, the patients are neither informed about the possible anti-cancer effects of simple vitamin D nor informed they will not be tested for vitamin D deficiency. Current research indicates that the vast majority of these cancer patients (both treatment and control groups) are likely to be vitamin D deficient.

The researcher then gives the treatment group the vitamin D analog and the control group gets a sugar pill. Most vitamin D analog studies have not shown any benefit or showed only slight improvement in the treatment groups. However, as both the treatment and control groups are usually advanced cancer patients, both groups usually end up dying without ever being tested or treated for routine vitamin D deficiency.

It is increasingly likely that physiological doses of vitamin D would help much more than the analogs. However, as you know, no one knows for sure because that question has never been studied. This year, hundreds of thousands of people around the world will die from cancer and most of them will be vitamin D deficient while they are battling their cancer.

Some analog researchers point out that some cancer cells lose the ability to activate vitamin D (transform vitamin D into calcitriol) and thus it makes no sense to study plain vitamin D. However, these researchers forget that the majority of cancer cells retain the ability to activate vitamin D and that calcitriol's anticancer activity is paracrine (around the cell), not just autocrine (inside the cell). They also forget that the only reasonable scientific vitamin D analog question is: "Do the vitamin D analogs add anything to the treatment of cancer patients who are vitamin D replete?"

The only scientific (and ethical) way to study the effect of vitamin D analogs in cancer patients is to treat both the control and the treatment groups with enough vitamin D until their blood tests show they are no longer vitamin D deficient. Then give the analog to the treatment group and the sugar pill to the control group. That way, any additive effect of the analog over simple vitamin D will be clear. However, you guessed it, that study has never been done.

The failure to conduct such studies lies both at the feet of the medical industry and at the feet of the National Institutes of Health or NIH. The NIH receives billions of dollars of your tax money to study such questions and is not supposed to be influenced by profit.

However, things are changing and we hope that the proper studies are now being designed. Unfortunately, they will take years to complete and be published. In the meantime, cancer patients continue to die vitamin D deficient.

What can you do? Three things: First, write your congressional representative and demand the NIH conduct studies on vitamin D and

cancer. Second, support the Vitamin D Council (contributions are tax deductible). Third, get enough vitamin D.

How much vitamin D should you take to prevent cancer? No one knows. It is a more complicated question than it first appears because most of us get most of our vitamin D from the sun, although we avoid the sun! We get a little in our diet, almost all of it from milk or fish, but none of us get enough from our diet. We also get some in multivitamins, but multivitamins only contain 400 units, about 10 % of the body's daily needs. It appears to us that the best thing to do is be conservative and maintain "natural" vitamin D blood levels year around. In this case, "natural" means calcidiol blood levels similar to humans living in a "natural" relationship with the sun, such as farmers in Puerto Rico or lifeguards in the USA. Both groups have calcidiol levels above 50 ng/ml.

How much vitamin D should you take if you have cancer? We don't know. No one knows. The research is just beginning. The only way to know how much might help is to either consult a knowledgeable professional (hard to find), read the current scientific literature (difficult to understand), or read our summations on this web site. No matter choice you make, in the end, you'll have to decide for yourself.

As we will say repeatedly, although "natural" amounts of vitamin D may help, it should only be taken in addition to standard cancer treatment. It is never the first or only treatment. It is always taken in addition to your regular chemotherapy or surgery. Oncologists and cancer surgeons work miracles every day.

Remember, vitamin D may be toxic in overdose although one expert recently said, "worrying about vitamin D toxicity is like worrying about drowning when you are dying of thirst." That said, many people think if a little is good then a lot is better. This is definitely not true about vitamin D. Forewarned is forearmed.

The Vitamin D Council sponsors this web site; we are a non-profit, tax-exempt organization dedicated to educating consumers and professionals about the epidemic of vitamin D deficiency. We are not your doctors and will not make any medical recommendations concerning vitamin D supplementation. We are in the process of writing an e-book discussing supplementation options and hope to be able to soon tell you what we think we would do if we developed cancer.

Breast Cancer

Breast cancer is the most common malignancy of women in the western world. Many factors contribute to causing breast malignancy (it is multifactorial) with heredity a major factor. Certain diets also help prevent it, such as diets high in vegetables and fruit and low in fat. Adequate calcium is very important. The role of vitamin D in both the prevention and treatment of breast malignancy is being intensively explored by scientists but is still preliminary.

No matter what cancer you have, or are trying to prevent, the real question is should cancer patients be left vitamin D deficient? Many experts will tell you that vitamin D should not be taken for breast cancer until well controlled scientific studies prove it helps. The problem with that approach is two-fold. First, you may die waiting for the studies to be conducted and two, it misses the point. The point is this: women with breast cancer should not allow themselves to be vitamin D deficient and neither should their doctors.

If you have breast cancer, please remember that vitamin D is not a cure-all and should never be used as the main treatment for your cancer. Your oncologist will prescribe treatment that has proven efficacy and you should carefully follow his/her advice as the mainstay of treatment. At the same time, you should know that evidence suggests that the proper amount of vitamin D may help you in your fight against breast cancer.

Next, let's look at selected studies from the scientific literature to see what clues exist about the role vitamin D may play in preventing, and treating, breast cancer.

In 1989, the prestigious medical journal, The Lancet, reported that the most active form of vitamin D (calcitriol or 1,25-OH-D) significantly reduced the growth of breast cancer in an animal model. Furthermore the researchers (from St. Georges Hospital medical School in London) found women who had vitamin D receptor positive tumors had longer disease free intervals than women whose tumors had no measurable receptors for vitamin D. Lancet. 1989 Jan 28;1(8631):188-91.

Current research suggests most, if not all, women would have those vitamin D receptors unless they were deficient in vitamin D, that is, they would have those receptors if they were vitamin D replete. It seems as if the receptor is present in breast tissue if the most active form of vitamin D has been present and that is only the case if the less-active form [the substrate, calcidiol or

25(OH)D] has been present. In other words, if you test vitamin D deficient breast cancer patients for vitamin D receptors, they will not have many; if you treat their deficiency, they will probably develop those receptors.

Not only does the active form of vitamin D, calcitriol (the form made in optimal quantities by your body when your vitamin D blood levels are ideal) inhibit breast cancer cells from growing, it makes those cells grow and die more like natural cells. Furthermore, vitamin D inhibits the formation of excessive blood vessel growth around the cancerous tumor, a process called anti-angiogenesis. Braz J Med Biol Res. 2002 Jan;35(1):1-9.

In the 1990's, a group of scientists from the University of California at San Diego provided the first look at how many women may be dying needlessly from breast cancer due to low vitamin D blood levels. The researchers measured the amount of sunlight available to the women at the latitude where they lived and combined that with the frequency of cloudy weather. Sunny climates are associated with higher vitamin D levels. They found that women in the sunniest regions of the USA were about half as likely to die from breast cancer as were women who lived in less sunny regions. When the same researchers looked at the USSR, before that country dissolved, they found that women who lived in the sunniest regions were three times less likely to develop breast cancer than were the women who lived in regions without as much sun.

. Prev Med. 1990 Nov;19(6):614-22.
0. Int J Epidemiol. 1990 Dec;19(4):820-4.

In 1994, a researcher at the Memorial Sloan-Kettering Cancer Center reviewed the literature up to that date and concluded that higher intakes of vitamin D and calcium might reduce breast cancer by protecting against the carcinogenic effects of a high fat diet. He also pointed out the vitamin D intakes were far below the government recommendations in force at the time. Adv Exp Med Biol. 1994;364:109-14.

In 1997, researchers at the Manchester Royal Infirmary discovered that women with the highest levels of activated vitamin D (calcitriol) in their blood had the best prognosis. Those women with the lowest levels had a more rapidly fatal course. They also found that women with breast cancer had low levels of 25(OH)D (calcidiol) in their blood with average levels of about 16 ng/ml. Women who live in sunny climates, where breast cancer is more rare, frequently have blood levels three times higher. J Clin Endocrinol Metab. 1997 Jan;82(1):118-22.

However, studies that measure the blood level of activated vitamin D, calcitriol [1,25(OH)D] miss the important fact that blood levels do not reflect tissue levels. In fact, blood levels of calcitriol are quite different than tissue levels which can not be measured. However, tissue levels can be estimated from calcidiol levels as calcidiol is converted into calcitriol in the tissues and that conversion is directly proportional to the blood level of calcidiol. Simply put, that means the higher your blood levels of calcidiol, the higher the tissue levels of calcitriol and the more activated vitamin D one has in her tissues to fight breast cancer.

In 1999, researchers at the University of North Carolina School of Medicine reported that white women with the lowest blood levels of calcitriol [1,25(OH)D] were five times as likely to develop breast cancer as were women with the highest levels but the relationships did not hold for black women. More importantly, the researchers found that women with breast cancer had very low levels of 25(OH)D in their blood with average levels of 15 ng/ml for white women while the level was only 8.9 ng/ml for black women, which is severely deficient. This extraordinarily low level of calcidiol in Blacks probably explained the researchers finding about calcitriol. Blacks were so deficient in vitamin D that their kidneys could not make enough calcitriol to compensate for their low calcidiol levels. Remember, as vitamin D deficiency worsens, the kidney activates more and more calcidiol into calcitriol to maintain serum calcium leaving very little left over for the tissues to fight cancer. Public Health Nutr. 1999 Sep;2(3):283-91.

Also in 1999, researchers the Northern California Cancer Center and the University of Miami, followed 5009 women for 20 years, as part of a large NHANES I study. 190 of the women subsequently developed breast cancer. The researchers did not have 25(OH)D (calcidiol) blood levels available, so they looked at many markers of vitamin D levels, such as living in sunny climates, sun damaged skin (indicted past sun exposure), a history of occupational and recreational sun exposure and dietary vitamin D.

All of these factors reduced the risk of breast cancer. Dietary vitamin D reduced the risk a little (due to the tiny doses of vitamin D consumed) but women with high occupational and recreational sun exposure who lived in a sunny climate reduced their risk three fold. Remember, 90 % of our vitamin D comes from sun exposure. Vitamin D from diet and supplements is close to insignificant due to the small amounts consumed. Cancer Epidemiol Biomarkers Prev. 1999 May;8(5):399-406.

In 2002, researchers at St. George's Hospital Medical School in London reviewed the multiple mechanisms by which activated vitamin D [calcitriol or 1,25 (OH)D] prevents breast cancer. calcitriol arrests the aberrant progression of breast cancer by regulating cell cycles, forcing apoptosis (cell death), resisting signals from substances that cause cancer cells to grow, inhibiting invasion into normal tissue and preventing metastasis. All in all, calcitriol, the most potent form of vitamin D, appears to be the perfect chemotherapeutic agent to both prevent and treat breast cancer. Unfortunately, the researchers appeared to be unaware that the best way to elevate tissue levels of calcitriol is to elevate blood calcidiol levels and the best way to elevate calcidiol levels is to take physiological doses of cholecalciferol. Endocr Relat Cancer. 2002 Mar;9(1):45-59.

Instead of giving simple cholecalciferol to patients with breast cancer, the medical-industrial complex continued to test the potentially profitable vitamin D analogs which are patenable variations of calcitriol. The vitamin D analogs are chemical modifications of calcitriol which try to retain calcitriol's ability to fight breast cancer while not causing the high blood calcium that calcitriol usually causes. Many different vitamin D analogs were tested and many worked great in the test tube. However, just like calcitriol, they usually caused high blood calcium when given to humans.

No one seemed to care that optimal doses of cholecalciferol would raise tissue levels of cancer fighting calcitriol quite high, would not cause hypercalcemia and should work well against breast cancer. Remember, cholecalciferol occurs naturally, can not be patented and is dirt cheap. Therefore, the idea it could help breast cancer offered no financial incentives to drug companies or researchers hoping to discover a drug they could patent. Also, few of the scientists working to cure cancer had any but the most rudimentary understanding of basic vitamin D physiology, pharmacology or toxicology. Recent Results Cancer Res. 2003;164:333-48.

Then, things started coming to a head in the last few years. In 2004, a group at the University Hospital in Quebec confirmed that vitamin D, especially when taken with calcium, significantly reduced abnormal mammograms. In fact they found women with the highest vitamin D intake had only one fourth as may abnormal densities on their mammogram as did women with the lowest intake. Cancer Epidemiol Biomarkers Prev. 2004 Sep;13(9):1466-72.

Researchers in Germany then tested fresh breast cancer cells to see if they could activate vitamin D. Up until then, only breast cancer cells grown in test tubes had been tested. The researchers found fresh breast cancer cells could indeed activate vitamin D. Indeed those cells seemed to be hungry for the vitamin D as the cells showed increased production of the enzymes necessary to activate vitamin D. It seemed all that was missing was the vitamin D. Recent Results Cancer Res. 2003;164:239-46.

Then researchers in Norway discovered that women who were diagnosed with breast cancer during the summer and fall, the season where vitamin D levels are the highest, had the best prognosis. The researchers concluded that high vitamin D levels during the course of cancer treatment may improve the prognosis of women with breast cancer. Colon and prostate cancer showed similar improvements. Cancer Causes Control. 2004 Mar;15(2):149-58.

What does all this mean? To date, no studies have been published correlating vitamin D blood levels with the progression of breast cancer although such studies have been done for prostate cancer. We know that most women with breast cancer are vitamin D deficient because most women in the industrialized world are vitamin D deficient. Furthermore, women with breast cancer tend to be older, chronically ill and are often Black, all risk factors for severe vitamin D deficiency.

Of course, many questions are unanswered. However, many questions are always unanswered, that is the nature of science. It certainly looks as if vitamin D supplementation should help reduce the rate of the growth of breast cancer but that is not proven.

Although no studies prove that vitamin D helps breast cancer, no studies have ever been done to answer that simple question. Hundreds of thousands of women will die this year from breast cancer and most will be vitamin D deficient.

If asked, most scientists will tell you that vitamin D should not be given to breast cancer patients until vitamin D is proved to be both safe and effective. However, that is not the question.

The question is, should breast cancer patients be allowed to die from their cancer while not being treated for their vitamin D deficiency. We dont think so, and neither would most victims.

Remember, vitamin D is always an ancillary treatment, never the primary treatment. However, to battle breast cancer with low vitamin D levels makes no sense and will likely reduce your risk of surviving the disease.

So the question is, what can you do now, based on what is known now. Say you cannot wait for science? The Vitamin D Council will not tell you what to do. We are a non-profit educational organization but we are not your doctors. We will not make any recommendations. In the future, we plan to publish an e-book that will tell you what we would do if we developed breast cancer.

Colon Cancer

Colorectal cancer is the second most common form of cancer in the western world. About 150,000 Americans will be told they have colon cancer this year and 50,000 will die. Your chance of developing colon cancer, sometime in your life, is about one in 15.

Many factors contribute to causing colon cancer (it is multifactorial) but diet is probably the most important factor. Certain diets promote colon cancer, such as diets high in fat and red meat and other diets help prevent colon cancer, especially diets high in fiber, calcium, fruits and vegetables. Scientists first discovered the possible importance of vitamin D in preventing colon cancer more than 20 years ago.

No matter what cancer you have, or are trying to prevent, the real question is should cancer patients be left vitamin D deficient? Many experts will tell you that vitamin D should not be taken for colon cancer until well controlled scientific studies prove it helps. The problem with that approach is two-fold. First, you may die waiting for the studies to be conducted and two, it misses the point. The point is this: people with colon cancer should not allow themselves to be vitamin D deficient and neither should their doctors.

If you have colon cancer, please remember that vitamin D is not a cure-all and should never be used as the main treatment for your cancer. Your oncologist will prescribe treatment that has proven efficacy and you should carefully follow his/her advice as the mainstay of treatment. At the same time, you should know that evidence suggests that the proper amount of vitamin D will help you in your fight against colon cancer. Next, let's look at selected studies from the scientific literature to see what clues exist about the role vitamin D may play in preventing, and treating, colon cancer.

In 1980, Cedric and Frank Garland, while at Johns Hopkins University,

reported that death from colon cancer was significantly less likely in those who lived in sunny areas. The Garland brothers believed vitamin D best explained this observation. Int J Epidemiol. 1980 Sep;9(3):227-31.

In 1985, scientists studied 2100 men for 19 years. They discovered that colon cancer was more than twice as likely in the men that consumed the least amount of vitamin D and calcium. As about 90% of the average persons vitamin D comes from the sun, it was comforting to know that even small amounts of vitamin D in the diet helped prevent colon cancer. Lancet. 1985 Feb 9;1(8424):307-9.

In 1989, the Garland brothers presented further evidence that vitamin D deficiency played a key role in colon cancer. They analyzed air pollution data from 20 Canadian cities finding that the cities where polluted air obscured vitamin D producing sunlight had higher death rates from both colon and breast cancer. Furthermore, they pointed out that colon cancer 4-6 times higher in North America and Northern Europe when compared to the incidence of colon cancer in countries close to the equator. Can J Public Health. 1989 Mar-Apr;80(2):96-100.

Later that same year the Garlands presented even stronger evidence, this time in the prestigious British journal, the Lancet. For the first time, researchers linked blood vitamin D levels to risk of developing colon cancer. They found an amazingly strong correlation that showed you were five times less likely to develop colon cancer if your calcidiol blood level was between 33-41 ng/ml. For the first time, a direct correlation was shown between vitamin D blood levels and the risk of getting colon cancer. As cancer is a dynamic process with normal cells turning cancerous as time progresses, this study strongly suggested that vitamin D may have an important role in treating colon cancer. Lancet. 1989 Nov 18;2(8673):1176-8.

In 1992, researchers at the University of Washington independently confirmed the Garland brothers work. They analyzed cancer registries in the USA and found people who live in cloudy northern areas, such as Michigan, Connecticut and western Washington were up to 80% more likely to develop colon cancer than those who lived in sunny areas like Utah and New Mexico. Cancer Causes Control. 1992 Jan;3(1):95-9.

In 1993, researchers from the University of Minnesota, analyzing the data of more than 35,000 women from the Iowa Womens Health Study, found that vitamin D and calcium in the diet significantly reduced the risk of colon cancer. Women with the lowest vitamin D intake were twice as likely to

develop colon cancer. Remember, diet supplies only 10% of the vitamin D as most people get almost all their vitamin D from sun exposure. Even so, this study confirmed earlier findings and showed that even small amounts of vitamin D in the diet were helpful. Am J Epidemiol. 1993 Jun 15;137(12):1302-17.

In 1996, researchers at Harvard confirmed that vitamin D taken in the diet or in supplements reduced the risk of colon cancer. Furthermore, they found supplemental vitamin D was more important than vitamin D from the diet. It is important to remember that little vitamin D is obtained from either diet or supplements, compared to the enormous quantities available from sunlight. Even so, the men with the highest total vitamin D intake were about 1/2 as likely to develop colon cancer compared to men with the lowest total intake. Am J Epidemiol. 1996 May 1;143(9):907-17.

Later in 1996, researchers at Harvard reported results for women. They followed 89,000 nurses over 12 years and found the nurse's risk of developing colon cancer was reduced by vitamin D, similar to men. In fact, they found the relative risk for women with the highest total vitamin D intake was .42, meaning those women with the lowest vitamin D intake were more than twice as likely to develop colon cancer. J Natl Cancer Inst. 1996 Oct 2;88(19):1375-82.

In 1997, researchers in Finland confirmed the Garland brothers' original findings on vitamin D blood levels and colon cancer. Again, they found that the risk of colorectal cancer was highest in those with the lowest blood levels. Perhaps more ominous for the people of Finland (which is very far north and gets little sunlight) was the very low levels of vitamin D in the blood of Finns. The average person in Finland had blood levels of only 13 ng/ml, a level now known to be associated with numerous serious illnesses, not just cancer. Cancer Causes Control. 1997 Jul;8(4):615-25.

Finally, in 1997, researchers at the University of Vienna first suggested that vitamin D may help treat colon cancer. They discovered that colon cancer cells, when grown in a test tube, retain the ability to make calcitriol, the active form of vitamin D that has multiple anticancer properties. They further proposed that calcitriol in the tissues may be nature's "defense strategy" to fight cancer. J Steroid Biochem Mol Biol. 1997 May;62(1):21-8.

In 1999, researchers in Israel, found that calcitriol levels were twice as high in patients with less aggressive colon cancer but were quite low in those with advanced metastatic disease. They concluded that higher calcitriol levels may

prevent "further transformation of the cells or may induce cell differentiation, growth inhibition or apoptosis (normal cell death)." That is, they suggested that higher serum calcitriol levels prevented the cancer from progressing, implying it might be useful in treatment, especially in early stages. However, it is important to remember, it is tissue calcitriol levels that are the most important in fighting cancer but they can not be measured. Colon tissue can make large amounts of tissue calcitriol, if and only if, enough calcidiol is available in the blood. Blood calcidiol levels can easily be increased by taking the correct amount of vitamin D supplements. Cancer. 1999 Aug 1;86(3):391-7.

In 2001, researchers at Boston University found that colon cancer cells can activate vitamin D, turning calcidiol into calcitriol. Their findings clearly implied that patients with colon cancer might be helped by optimizing the amount of calcidiol in their blood. The authors even warned that "vitamin D deficiency could accelerate colon cancer growth." That is, the cancer cells themselves can make calcitriol, if enough calcidiol is available for them to do so. Remember, every molecule of calcitriol in your tissues comes from a molecule of calcidiol in your blood. Lancet. 2001 May 26;357(9269):1673-4.

Later in 2001, researchers at the University of Vienna confirmed that colon cancer cells can make calcitriol but noted that ability may be lost as the cancer progresses or in highly aggressive, poorly differentiated tumors. Furthermore, they warned that one of the metabolites of calcitriol is increased in poorly differentiated tumors and that metabolite may be stimulating the tumors to grow. Biochem Biophys Res Commun. 2001 Jul 27;285(4):1012-7.

In 2002, researchers at St. Luke's-Roosevelt Hospital in New York were the first to administer vitamin D to humans to see if it reduced precancerous cellular changes in the colon. Rectal biopsies were performed before and after the administration of vitamin D and calcium. One group got only calcium, the second group got calcium and vitamin D (only 800 units) and the third group took calcitriol twice a day. The researchers found no improvement between groups, but, much to their surprise, they found strong correlations between calcidiol blood levels and precancerous lesions. As blood calcidiol levels increased, precancerous cellular changes decreased, especially when combined with calcium. The fewest precancerous changes were in a patient with a calcidiol level of 60 ng/ml. Cancer Epidemiol Biomarkers Prev. 2002 Jan;11(1):113-9.

In 2002, researchers from the University of Helsinki showed that soy extracts significantly increase the production of calcitriol in mouse colon both by increasing its production and by decreasing its degradation. This discovery explained the well-known fact that populations that consume high amounts of soy products have lower cancer rates. J Nutr. 2002 Nov;132(11 Suppl):3490S-3493S.

Later in 2002, researchers from the National Cancer Institute confirmed the Garland brothers finding from 20 years earlier. Sun exposure significantly reduced ones risk of dying from colon cancer. Occup Environ Med. 2002 Apr;59(4):257-62.

In 2003, researchers at Dartmouth confirmed that deficiencies of both vitamin D and calcium were involved in the reoccurrence of colon polyps, a condition known to lead to colon cancer. It turns out both calcium and vitamin D work together to prevent colon cancer. J Natl Cancer Inst. 2003 Dec 3;95(23):1765-71.

What does all this mean? A wide variety of evidence is converging, telling us that high vitamin D levels both prevent colon cancer and retard its progression when the cancer is caught early. No studies prove that vitamin D helps colon cancer, but, tragically, no studies have ever been done to answer that simple question. Hundreds of thousands of people will die this year from colon cancer and many will be vitamin D deficient.

If asked, most scientists will tell you that vitamin D should not be given to colon cancer patients until vitamin D is proved to be both safe and effective. However, that is not the question.

The question is, should colon cancer patients be allowed to die from their cancer while not being treated for their vitamin D deficiency. We don't think so, and neither would most victims.

We can't tell you what to do. However, the Vitamin D Council plans to publish an e-book in the near future that will tell you what we would do if we were diagnosed with colon cancer.

Prostate Cancer

Prostate cancer kills 31,000 American men every year, the second leading cause of cancer deaths among men. This year, more than 220,000 American

men will be diagnosed with the disease, making prostate cancer the leading cancer among men. Early diagnosis is important as surgery can be curative. After the cancer has spread, especially to bone, treatment options are more limited. Castration, usually chemical, will delay the cancer from spreading for several years, but then the treatment options are quite limited.

No matter what cancer you have, or are trying to prevent, the real question is should cancer patients be left vitamin D deficient? Many experts will tell you that vitamin D should not be taken for prostate cancer until well controlled scientific studies prove it helps. The problem with that approach is two-fold. First, you may die waiting for the studies to be conducted and two, it misses the point. The point is this: men with prostate cancer should not allow themselves to be vitamin D deficient and neither should their doctors.

If you have prostate cancer, please remember that vitamin D is not a cure-all and should never be used as the main treatment for your cancer. Your oncologist will prescribe treatment that has proven efficacy and you should carefully follow his/her advice as the mainstay of treatment. At the same time, you should know that evidence suggests that the proper amount of vitamin D may help you in your fight against prostate cancer.

Next, let's look at selected studies from the scientific literature to see what clues exist about the role vitamin D may play in preventing, and treating, prostate cancer.

In 1990, Schwartz proposed that Vitamin D deficiency may underlie the major risks for prostate cancer, including age, Black race, and northern latitudes. He pointed out that all these factors are associated with decreased synthesis of Vitamin D. Mortality rates from prostate cancer in the U.S. are inversely correlated with ultraviolet radiation, the principal source of Vitamin D. Anticancer Res. 1990 Sep-Oct;10(5A):1307-11.

In 1992, Hanchette and Schwartz again proposed that sunlight and vitamin D may play a role in prostate cancer. They pointed out that men in the United States were ten times more likely to develop prostate cancer than men in Japan, where men consume higher amounts of vitamin D due to their consumption of fatty fish. Although the authors did not mention it, Japanese men also consume soy, which inhibits the breakdown of calcitriol (activated vitamin D) in the tissues. Furthermore, traditional Japanese men consume higher quantities of omega-3 fatty acids their American counterparts and such fats are now known to dissociate vitamin D metabolites from their binding protein, thus raising the free, or active, levels of those metabolites in

the blood.

To support their hypothesis, Hanchette and Schwartz analyzed American prostate cancer deaths in relation to sunlight and discovered a .0001 negative correlation, a very significant association. That is, they found that men who received more sunlight were less likely to die from prostate cancer. Cancer. 1992 Dec 15;70(12):2861-9.

In the same year, Schwartz discovered that death rates from prostate cancer were correlated with death rates from multiple sclerosis, another disease know to be associated with lack of sunlight. Again, he proposed that lack of vitamin D may a causative factor in both diseases. Neuroepidemiology. 1992;11(4-6):244-54.

In 1993, Skowronski and colleagues discovered that all three of the prostate cancer cell lines they studied possessed a vitamin D receptor and the active form of vitamin D, calcitriol, "dramatically inhibited" the growth of two of the three cell lines. Endocrinology. 1993 May;132(5):1952-60.

Over the next several years, four studies appeared to disprove the vitamin D hypothesis. In each case, various metabolites of vitamin D were drawn on large numbers of men who were then followed over many years to see which men developed prostate cancer. Although some of the studies found that activated vitamin D (calcitriol) levels in the blood protected against colon cancer, none of the studies showed that low calcidiol levels (25 hydroxy-vitamin D) were associated with risk of developing prostate cancer. Schwartz's hypothesis appeared to be disproved.

. Cancer Epidemiol Biomarkers Prev. 1993 Sep-Oct;2(5):467-72.
0. Cancer Causes Control. 1995 May;6(3):235-9.
0. Cancer Epidemiol Biomarkers Prev. 1996 Feb;5(2):121-6.
0. Cancer Causes Control. 1998 Aug;9(4):425-32.

However, in 1995 Miller and colleagues expanded their earlier work and examined seven prostate cancer cell lines. They found all seven lines had receptors for vitamin D. They also showed that activated vitamin D (calcitriol) inhibited the growth of four of seven prostatic carcinoma cell lines and found that the more vitamin D receptors, the greater the inhibition. Furthermore, they found that the enzyme that breaks down calcitriol in the tissues (24-hydoxylase) reduced that inhibition. That is, the more 24-hydroxylase, the less the cancer cells were inhibited by activated vitamin D. Not only did this mean that activated vitamin D may retard prostate cancer growth, it suggested that substances which interfere with 24 hydroxylase

may also prove useful in treating prostate cancer. Clin Cancer Res. 1995 Sep;1(9):997-1003.

Later in 1995, Feldman and colleagues at Stanford University confirmed Miller's findings and stated, "Based on these findings, we postulate that vitamin D may have protective actions on the development and/or progression of prostate cancer. . . We further hypothesize that vitamin D supplementation may have beneficial effects on retarding the development and/or progression of prostate cancer." For the first time, cancer researchers at a major university seemed to be saying that evidence existed that cholecalciferol (plain vitamin D) may be useful in preventing and treating prostate cancer. Adv Exp Med Biol. 1995;375:53-63.

In 1998, Gross and colleagues at Stanford conducted the first clinical trial of a vitamin D metabolite in treating advanced prostate cancer. However, instead of raising the tissue levels of activated vitamin D (calcitriol) by supplementing with oral vitamin D (cholecalciferol), they chose to give calcitriol itself. In spite of circumventing the natural system to raise prostate calcitriol levels, they found calcitriol decreased the rate of progression of PSA blood levels (a test of prostate cancer's progression) in 6 of the 7 patients. Elevations in blood calcium levels (hypercalcemia) seriously limited the use of calcitriol and the cancer eventually progressed. (No one knows what would have happened to those seven men if they had been given equipotent doses of vitamin D (cholecalciferol). Cholecalciferol has to be given in massive doses (40,000 units) over an extended period of time (months) to cause significant hypercalcemia. In addition, the tissue production of calcitriol is not rate limited, suggesting that oral cholecalciferol is effective in raising tissue levels of calcitriol). J Urol. 1998 Jun;159(6):2035-9

In 1998, Schwartz, the same scientist who had first postulated that vitamin D deficiency played a role in prostate cancer, confirmed that prostate cells, including most prostate cancer cell lines, were able to activate vitamin D. Schwartz and his colleagues concluded that "these data suggest a potential role for 25-OH-D (calcidiol) in the chemoprevention of invasive prostate cancer." As the easiest way to raise calcidiol is through oral supplementation with vitamin D, this meant scientists at another major American medical school were suggesting that plain, cheap, non-prescription vitamin D may help prostate cancer. Cancer Epidemiol Biomarkers Prev. 1998 May;7(5):391-5.

In the year 2000, Ahonen and colleagues conducted a careful study of

calcidiol levels in young men and followed them for the development of prostate cancer. Unlike earlier studies, he found a relationship between low vitamin D blood levels and prostate cancer. Ahonen found young men with calcidiol levels below 40 nm/L (16 ng/ml) were three times more likely to develop prostate cancer than were men with higher levels.

Just as important, he found these men were six times more likely to develop invasive cancers. This finding implied a treatment effect for vitamin D as the prevention of invasiveness is a key goal of treatment. Cancer Causes Control. 2000 Oct;11(9):847-52.

Later in 2000, Barreto and colleagues at Wake Forest University School of Medicine were the first see if calcidiol inhibited prostate cell growth. They found that calcidiol was just as effective as calcitriol in inhibiting growth. The concluded that their findings "support the use of 25 (OH)D (calcidiol) as a chemotherapeutic agent in the treatment of prostate cancer." As oral cholecalciferol is the best way to raise calcidiol levels, it became clear that another group of cancer researchers at a major university medical center was calling for the use of vitamin D in prostate cancer. Cancer Epidemiol Biomarkers Prev. 2000 Mar;9(3):265-70.

Chen and colleagues at Boston University School of Medicine then demonstrated that calcidiol was just as effective as calcitriol in inhibiting growth of prostate cancer cell lines in the test tube. They also found that a vitamin D analogue already on the market, one known to cause less hypercalcemia that other analogues, was also effective in inhibiting cancer growth. (Vitamin D analogues are patentable modification of calcitriol.) However, their findings about calcidiol again emphasized that readily available vitamin D should help fight prostate cancer. In fact, the authors concluded calcidiol might be a good candidate for "human trials in prostate cancer." Now four different groups of scientist, from four major university medical centers, were calling for the use of vitamin D in prostate cancer. Clin Cancer Res. 2000 Mar;6(3):901-8.

In 2001, Luscombe and colleagues at the School of Medicine in North Straffordshire Hospital in England published three studies linking ultraviolet exposure and skin type to the development of prostate cancer. They found that cumulative outdoor exposure, outdoor occupations and skin type was associated with reduced risk of advanced stage tumors. They also found that childhood sunburns dramatically reduced the risk of developing prostate cancer, probably because those with fair skin are more likely to burn but also

find it easier to make vitamin D in their skin. Furthermore, the found that people who have difficulty making a skin pigment called melanin (a natural sun screen) are much less likely to develop prostate cancer.

0. Br J Cancer. 2001 Nov 16;85(10):1504-9.
0. Carcinogenesis. 2001 Sep;22(9):1343-7.
0. Lancet. 2001 Aug 25;358(9282):641-2.

In addition, in 2001, Zhao and Feldman at Stanford University studied the one prostate cancer cell line (DU 145) that does not respond to calcitriol. They found this cell line, which is poorly differentiated and derived from brain metastasis, can be made to respond to calcitriol by adding drugs which inhibit the breakdown of calcitriol. This raised the possibility that prostate cancers which did not respond to vitamin D could be made responsive by the addition of a metabolic inhibitor. Farhan and colleagues at the University of Vienna Medical School soon showed that the isoflavonoid, genistein, (which is found in soybeans) is a powerful metabolic inhibitor of the enzyme that breaks down calcitriol.

0. Steroids. 2001 Mar-May;66(3-5):293-300.
0. J Chromatogr B Analyt Technol Biomed Life Sci. 2002 Sep 25;777(1-2):261-8.

In 2003, Chen and Holick at Boston University School of Medicine reiterated their call for the use of vitamin D in prostate cancer. After reviewing most of the research on the subject, the authors concluded, "adequate exposure to sunlight or oral supplementation might provide a simple way to increase synthesis of calcitriol in the prostate and, therefore, decrease the risk of prostate cancer." They added, "adequate vitamin D nutrition should be maintained, not only for bone health in men and women, but because it might decrease the risk of prostate cancer and mitigate metastatic disease should it develop." Trends Endocrinol Metab. 2003 Nov;14(9):423-30.

In 2003, Bodiwala and colleagues in England studied sun exposure and skin type and again found that men who sunbathed or otherwise exposed themselves to sunlight were less likely to develop prostate cancer. They also identified men with various combinations of skin type and reduced sun exposure, which were up to 13 times more likely to develop prostate cancer.

. Cancer Lett. 2003 Oct 28;200(2):141-8.
0. Carcinogenesis. 2003 Apr;24(4):711-7.
0. Cancer Lett. 2003 Mar 31;192(2):145-9.

Also in 2003, Beer and colleagues at the Oregon Health and Science University again tested calcitriol as a treatment for prostate cancer. They

found a significant reduction in the rate of increase in PSA, a marker of the cancer's growth although no patient achieved the hoped for 50% reduction. Unfortunately, none of the patients received oral vitamin D supplementation, which would more effectively raise prostate calcitriol levels. In fact, none of the patients were even tested or treated for vitamin D deficiency. Cancer. 2003 Mar 1;97(5):1217-24.

In 2003, two studies from at the University of Vienna Medical School confirmed that the isoflavonoids in soy dramatically reduce the breakdown of calcitriol in prostate cancer cells. In fact, they found that such products profoundly inhibit the enzyme that metabolizes calcitriol, reducing its activity to almost zero. This again raised the possibility that such compounds could be combined with vitamin D to treat prostate cancer.

0. Recent Results Cancer Res. 2003;164:413-25.
0. J Steroid Biochem Mol Biol. 2003 Mar;84(4):423-9.
0. J Nutr. 2004 May;134(5):1207S-1212S.

Three studies in 2004 examined the association between vitamin D levels and prostate cancer. Two of the studies found no association between vitamin D levels and the subsequent risk of developing prostate cancer. A third study, from Finland, actually raised the possibility that both low and high vitamin D levels are associated with prostate cancer.

Careful analysis of the Finnish paper revealed 57 of the 67 men with high vitamin D blood levels who subsequently developed prostate cancer were from Norway. In Norway, increased consumption of vitamin A (associated with increased risk of prostate cancer) through cod liver oil is common.

In addition, in a letter to the editor, Reinhold Vieth proposed that that the Finnish finding was best explained by annual variations in calcidiol levels causing low tissue calcitriol levels. In their response to Vieth, the authors accepted his explanation as the probable cause for their findings and also proposed that tissue calcidiol levels, not just tissue calcitriol levels, may be protective.

0. J Steroid Biochem Mol Biol. 2004 May;89-90(1-5):533-7.
0. Cancer Causes Control. 2004 Apr;15(3):255-65.
0. Int J Cancer. 2004 Jan 1;108(1):104-8.

Then, researchers in Norway showed that patients diagnosed with prostate cancer in the summer and fall, when vitamin D levels are the highest, have a significantly better prognosis than patients diagnosed in the winter or spring. The authors concluded that their "study supports the hypothesis that vitamin

D may influence cancer specific mortality in a beneficial way. A possible mechanism to explain our results might be a combined action of vitamin D and cancer treatment that amplifies the treatment effect. In confirmed, in addition to traditional cancer treatment, vitamin D would be of particular importance in the primary prevention of deaths from cancer." Cancer Causes Control. 2004 Mar;15(2):149-58.

Lu and his group from Finland then demonstrated for the first time that calcidiol [25(OH)D] is an active steroid hormone in prostate cells. Up until this time, most scientists believed calcidiol was only a prehormone and had to be metabolized into calcitriol before it could regulate genes. Although much less potent than calcitriol, calcidiol is present in much higher concentrations. It now appeared calcidiol is a steroid hormone as well and active in suppressing cell proliferation in prostate tissue. FASEB J. 2004 Feb;18(2):332-4. Epub 2003 Dec 04.

Young and his group at Boston University School of Medicine then confirmed that tissue calcitriol concentrations are virtually uncontrolled. That is, the usual mechanisms that regulate blood calcitriol concentrations, calcium and parathormone, do not regulate tissue calcitriol levels in prostate cells. In fact, calcitriol did not exhibit negative feedback, and reduce its own production, until pharmacological amounts of calcitriol were introduced. The authors also pointed out that soy would further increase tissue levels and concluded their finding should "encourage the further development of nutritionally-based models for prostate cancer chemoprevention using vitamin D." Carcinogenesis. 2004 Jun;25(6):967-71. Epub 2004 Jan 16.

In late 2004, Woo, Vieth and colleagues from the University of Toronto presented a groundbreaking paper at the November NIH conference on vitamin D and cancer. They showed that 2,000 units of simple vitamin D (cholecalciferol) either reduced or prevented further increases in PSA in the majority of men with advancing prostate cancer. For the first time, a human interventional trial indicted that simple vitamin D was effective in fighting cancer.

What does this mean? It may mean a lot if you have prostate cancer. Of course, many questions are unanswered. However, many questions are always unanswered, that is the nature of science. It certainly looks as if vitamin D supplementation may help reduce the rate of the growth of prostate cancer.

Only one human study shows that vitamin D helps prostate cancer, but,

tragically, no other studies have been done to address that simple question. Hundreds of thousands of people around the world will die this year from prostate cancer and many will be vitamin D deficient.

If asked, most scientists will tell you that vitamin D should not be given to prostate cancer patients until vitamin D is proved to be both safe and effective. However, that is not the question. The question is, should prostate cancer patients be allowed to die from their cancer while not being treated for their vitamin D deficiency. We don't think so, and neither would most victims.

The questions is, what can you do now, based on what is known now. Say you cannot wait for science? The Vitamin D Council will not tell you what to do. We are a non-profit educational organization but we are not your doctors. We will not make any recommendations. In the future, we plan to publish an e-book that will tell you what we would do if we developed prostate cancer.