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The Most Important Stealth Factor to Improve Your Health

Analysis by Dr. Joseph Mercola Fact Checked | April 17, 2022

STORY AT-A-GLANCE

- Minerals play a crucial role in the activation of enzyme pathways, which are responsible for metabolism. This, in part, is what makes minerals so foundational for good health. If you don't have the required minerals, the "batteries" of your cells, the mitochondria and the nuclei, won't work. Inflammation is poor energy production, and the reason goes back to mitochondrial dysfunction

- Iron and copper are highly interdependent and need to be considered together. If you don't have copper in your diet, hemoglobin production becomes impaired, along with many other aspects of iron metabolism. So, being anemic does not automatically mean that you're iron deficient. You may be deficient in copper. Anemia typically relates to iron dysfunction or dysregulation, not deficiency

- The best way to lower excessive iron is to donate blood, one to four times a year. Most adult men and postmenopausal women have high iron and could benefit from regular blood donation, as high iron is extremely toxic and destroys health. An even better strategy is to remove smaller amounts of blood every month and a recommended schedule is provided

- To raise your copper level, you could use a copper supplement, but foods like grass-fed beef liver, bee pollen and whole food vitamin C are better

- If you're a farmer or grow your own food, the best way to put copper back into the soil, to get it into the food, is to add copper sulfate. Before you plant, simply spray the soil with copper sulfate, 10 to 15 pounds per acre

Morley Robbins, MBA, CHC,[1] founder of the Magnesium Advocacy Group and best known as the Magnesium Man, has also written a book called "**Cu-RE Your Fatigue: The Root Cause and How to Fix It on Your Own**."

In this book, he goes well beyond magnesium into other nutrients such as copper, iron, vitamins A and D and more, and his Root Cause Protocol[2] is the implementation of that information. I'm impressed with the book because Robbins covers every basic cause for disease that I am aware of. Most people who write about health will miss a few, but I believe he really nails all of them.

The Importance of Copper

Minerals play a crucial role in the activation of enzyme pathways, which are responsible for metabolism. This, in part, is what makes minerals so foundational for good health.

If you don't have the required minerals, the "batteries" of your cells, the mitochondria, won't work properly. In a nutshell, good health depends on ample and robust energy production and utilization, and for that, you need copious amounts of highly-functioning mitochondria that have limited oxidative stress.

Robbins describes mitochondria not as a power plant but as a factory. And what goes on in a factory? Of course, there's activity that depends on an energy source, but there's also movement of raw materials, the production and movement of end products, and the recycling of them.

> *"People don't think about that — and the fact that the mitochondria are connected to both the endoplasmic reticulum and the lysosomes,"* Robbins says. *"Well, suddenly you've got lysosomes being the recycling center and the endoplasmic reticulum being where the proteins are going to get made. It's like a completely different idea.*
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> *We all have this image from our high school biology class of what the picture of a cell looks like, and it has one or two mitochondria. Well, I've come to realize*

that that picture was drawn by Walt Disney, because it's a complete distortion of reality.

The average cell has 500 mitochondria; the average liver cell has 2,000 mitochondria; kidney cell, 4,000 mitochondria; heart cell, 10,000 mitochondria. The mature eggs in a woman's body have anywhere from 100,000 to 600,000 mitochondria.

And then the brain region, the substantia nigra, it has 2 million mitochondria per neuron. That's a game changer, when you begin to understand the concentration of activity."

As an example, Parkinson's disease is rooted in defective mitochondrial function in this area of the brain. According to Robbins, by the time you get a diagnosis of Parkinson's, 66% of those neurons are dead. Multiply 66% times 2 million mitochondria per neuron, and you realize we're talking about a massive loss of mitochondrial energy.

Conventional medical doctors will typically prescribe L-DOPA to treat Parkinson's, but that actually makes the situation much worse in the long run, and in no way, shape or form addresses the loss of these mitochondria. "This whole concept of energy production is so essential, and it's overlooked," Robbins says.

Inflammation Is a Lack of Energy

Another description of "lack of energy" is inflammation, Robbins says. Inflammation is poor energy production, and the reason goes back to mitochondrial dysfunction. He likens mitochondria to a two-stroke engine with two copper centers, Copper A (two Copper atoms) and Copper B (with one Copper atom).

Copper A is the easy stroke that produces hydrogen peroxide (H_2O_2), which is a source of oxidative stress. The hydrogen peroxide then needs to be turned into two molecules of water (H_2O). If your body keeps producing H_2O_2 rather than water, it's because you don't have enough copper to achieve the transformation into two molecules of H_2O.

This typically implies that the Cytochrome c Oxidase enzyme in Complex 4 of the mitochondrial electron transport chain is not doing its job. And as hydrogen peroxide builds, you end up with loads of free radicals that results in mitochondrial oxidative damage.

> *"We live on a planet that has two very active elements, oxygen and iron, and we know they don't mix well, because they create rust,"* Robbins says. *"Yet the terminal destination for both iron and oxygen are the mitochondria. That's an important thing to understand. And so, inside these organelles, these factories, are a series of proteins that are loading electrons onto oxygen and hydrogen.*
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> *The term used in the literatures is we're activating oxygen and hydrogen to create water. The mitochondria are water wheels, they're the source of water in our metabolism. And when minerals are in optimal levels, we can make water.*
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> *And once we make water — which implies the pH of 7, because that's when water exists — that releases the precursor to energy, called ADP. ADP goes over to another complex to become ATP. And, as many people might know, those proteins, ADP and ATP, actually have magnesium in them to give them structural integrity. It's a very important aspect of energy dynamics."*

The Role of Mitochondrial Complexes

Inside the electron transport chain (ETC) in the mitochondria are five complexes. Complex 1, 3 and 4 work together as a unit and are known clinically as the "Respirasome." Complex 4, also known as Cytochrome c Oxidase (CcOX), is an electron shuttle that has multiple elements of copper in it. It's actually a dimer, so that means there are actually six atoms of copper, and the job of those copper atoms is to turn oxygen into water.

> *"Here's where I think it gets really fascinating. Every kitchen has a stove, right? And they're usually made of iron, steel, and they're cooking something. But does*

> *the stove run itself? Does the stove know what food to put into the pot? What temperature? How long to keep it on?*
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> *Of course not, it needs a chef. I call them Cuisine artists, so we can see the symbol for copper, Cu, and I for iron. And so, inside Complex 4, there is a stove, and it's called heme a3. It holds oxygen.*
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> *And then Copper B comes along and slices and dices, it lets the electrons and hydrogen flow through, and voila, we have water. Then, that releases ADP to go over to Complex 5, which is called ATP Synthase, and it's like a rotor, a little motor inside the mitochondria. These are stacked like pancakes. We don't really know how many Complex 5s are in one mitochondria, it could be hundreds, it might be thousands.*
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> *But they're each spinning at 150 revolutions per second, and every time it goes around, it's releasing three Mg-ATP. Just think of the vortex of thousands of these little rotors inside one mitochondria, much less thousands, hundreds of thousands, millions. The sheer elegance of the design of human physiology is absolutely amazing."*

Complex 4, or CcOX, is an electron shuttle, and needs retinol (vitamin A) to function. Robbins explains there's a four-part component called the Signalosome, but:

> *"... if retinol isn't there in adequate levels, it's going to set the stage for what's called the Warburg effect. And that's going to take us down a whole different bunny trail, but whoever knew about retinol being critical for energy production? That's not something typically discussed in clinical circles."*

Retinol is not the same as beta-carotene. There are no plant sources of retinol, it only comes from animal sources, which is yet another profoundly good reason to regularly include animal foods in your diet. Butter, heavy cream, egg yolks, liver and CLO are particularly high in retinol. Your body can make retinol from beta-carotene, but ONLY if you have adequate copper in the tissue to activate BCMO enzyme.

Why Sun Exposure Is so Important

Another important point to understand is that while sun exposure is important for making vitamin D, it is also crucial for transforming retinol into its active metabolites, called retinoids. There are nuclear receptors and retinoic acids, which are hormones, that are incredibly important. The nuclear receptors allow your thyroid to work, for example, by binding TR (Thyroid Receptor) to RXR (a key Retinoid X Receptor. With absent adequate RXR, the condition is called hypothyroidism.

Infrared radiation from sunlight also triggers the production of melatonin in your mitochondria. So, when you're getting sun exposure, you're accomplishing three very important things.

You're activating vitamin D, you're converting vitamin A to its active form, which allows vitamin A to perform its many regulatory functions, and you're producing melatonin in the mitochondria, which radically reduces oxidative stress in the mitochondrial factories.

As explained by Robbins, vitamin A is a light sensor and vitamin D is a light filter. "It's a fascinating concept to think of those as parallel yin-yang functions," he says. "They need to be considered together."

> **"Being anemic does not automatically mean that you're iron deficient. You may be deficient in copper. Anemia is really iron dysfunction or dysregulation."**

Similarly, iron and copper need to be considered together. "Iron serves at the pleasure of copper enzymes," Robbins says. If you don't have copper in your diet, you can't make hemoglobin and you cannot properly metabolize Iron. So, being anemic does not automatically mean that you're iron-deficient. You may be deficient in copper. Anemia is really iron dysfunction or dysregulation.

If you're a farmer or grow your own food, the best way to put copper back into the soil, to get it into the food, is to add copper sulfate. Before you plant, simply spray the soil with copper sulfate, 10 to 15 pounds per acre. Most farmers merely use NPK (nitrogen, phosphorous and potassium) fertilizer and NPK blocks copper uptake in the plants, which was highlighted by Andre Voisin, Ph.D., in his 1957 classic (which, sadly, is now out of print): "Soil, Grass & Cancer."

Iron Toxicity Is Likely Your Biggest Health Danger

Unfortunately, the focus on iron loading can be disastrous, as excess iron increases oxidative stress. Robbins explains:

> *"Iron dysregulation is the elephant in the room. It is front and center of why we have metabolic dysfunction. When we go back into the mitochondria, again, they're not just making energy. They are critical recycling centers. Again, if iron has a terminal destination in the mitochondria, that means it needs to be recycled.*
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> *What's it's supposed to be recycled into? It's either going to become a heme group or it's going to become iron sulfur clusters. Those are the two principal sources of using iron in the body, beyond the dominance that hemoglobin plays.*
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> *It turns out that to make heme and to make iron sulfur clusters, we've got to have copper. Four of the eight enzymes to make heme are copper dependent and found within the mitochondrial matrix, and the rate limiting variable in making iron sulfur clusters, Glutaredoxin-5, requires copper.*
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> *If, in fact, there is a deficiency in copper — which I would argue exists because farming and food processing have lowered copper's presence in the soil and in the food — by virtue of that, the concentration of copper in the mitochondria has changed.*
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> *It is lower today than it was 90 years ago. It's been the No. 1 nutrient deficiency on the farm for 80 years. At the same time, what the World Health Organization*

will tell you is that iron deficiency is the No. 1 nutrient deficiency. Well, those two are connected and they don't know that ...

There are 50,000 atoms of copper in each mitochondrial matrix. That's a big deal. If the copper's not there, then the heme enzymes and the iron sulfur cluster enzymes are not going to work right. Iron is going to start to build in the mitochondria and then ultimately into the tissue.

It's going to go into what's called mitoferrin, a storage locker in the mitochondria, and then it might spill out into the ferritin inside the cell itself. When that starts to build, it's called the labile iron pool (LIP), and labile does not mean happy. It does not mean free. It means REALLY reactive.

It's important to understand what that word means. As that iron is rising, there can be a 40% loss of energy, a 60% loss, 80% loss up to a 94% loss of energy [because] it's damaging the ETC [electron transport chain] — Complexes 1, 3 and 4. It's also affecting the ability to work with oxygen. There's just a wholesale breakdown.

*In simple terms, it's rust ... Complex 4 must turn oxygen into water. If that doesn't happen, you're going to create super oxide. That's an oxygen molecule with an extra electron. It's not super, it's actually Hyper-oxide. You're going to create hydrogen peroxide. You're going to create the hydroxyl radical [*OH].*

These are violently reactive, and ... it begins to increase the acidity inside the cell. When the cell becomes more acidic, it can't make energy. And that's ultimately what iron is doing. It's causing this increased acidity because of its reactive nature with oxygen and these proteins in the ETC."

Why Blood Tests Aren't Dependable

As noted by Robbins, there's a big difference between iron deficiency in the blood and iron dysregulation in the mitochondria and in the cell. This is something that's not adequately understood.

In 2004 biochemist Bruce Ames determined there's 10 times more iron in the cell than in the blood.[3] This means the blood tests we rely on are not accurate. They don't reveal the whole story of iron metabolism. You need to measure iron activity in several ways, such as:

CBC	Serum zinc
Serum copper	Serum ceruloplasmin
Transferrin percent saturation	Ferritin, Total Iron Binding Capacity, serum iron and hemoglobin
Serum retinol	

Where Is Most Iron Stored?

So, where is most of the iron in the body, and what is the most accurate reflection of that? According to Robbins, inside your body, the ideal ratio of iron to copper is, on average, 50-to-1. Ideally, you would have about 5,000 milligrams of iron and about 100 mg of copper in your body.

The highest concentrations of iron, 70%, is in the hemoglobin. So, ideally, in your blood you would have about 3,500 mg of iron, but there is only 1 mg of copper. Now, inside your bone marrow, where blood is actually made, you'd have about 24 mg of iron and 47 mg of copper. Your body is very dependent on copper to make that blood. When copper is deficient, your hemoglobin level will decline.

Robbins cites 2021 research by Yohan Kim and Rocio Perez-Gonzalez that showed when you eliminate copper, iron loading takes place in the liver, and the gene responsible for that is a gene that's affected by loss of copper.

High Ferritin Is Not a Sign of Iron Sufficiency

So, getting back to the issue of anemia. What does that actually mean? Where is the iron? As explained by Robbins, the iron is stuck, because it can't properly recycle. Ideally, iron isn't stored but rather continuously recycled. Ferritin is an iron storage protein, which measures iron in the tissues, but not when it shows up in the serum, which is far more important.

Years ago, Robbins asked Dr. Douglas Kell, a world-renowned iron researcher, "What is the ideal ferritin level for a human?" His answer: Zero. Robbins thought he was joking, but he was not. Kell told him, "Rising ferritin is not a sign of iron vitality. It's a sign of organ pathophysiology."

Unfortunately, few doctors understand this. In conventional medicine, anyone with a ferritin level of 20 is assumed to have iron deficiency. So, how can you properly diagnose what's going on? Robbins explains:

> *"Here's how I explained it to the Amish farmers to make sure they understood it. I said, 'If you want to know how many bales of hay you have in your barn, would you go out in the field and start counting them?' And they went, 'No.' Well, that's what they're doing with blood tests.*
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> *The ferritin protein is designed to be **inside** the cell. What Dr. Kell was pointing out is that under intense inflammation, there's a change in how the lysosomes work to break down the ferritin protein and then allow for the recycling of the iron.*
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> *We're getting at some really esoteric physiology and I'm going to try to keep it really simple. The narrative is that serum ferritin is an accurate indication of ferritin in the cell. No, it's not. This idea that looking inside the blood is going to be an indicator of what's happening inside the cell is a leap of faith.*
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> *My sweet spot is between 20 and 50. When Dr. Kell said zero, I said, I don't think people would believe me if I said zero. So, I went back into the research and 20 to 50 seems to be an acceptable tolerance. What I've learned is that, in the blood testing, when the serum ferritin for a woman gets above 150, that's when*

the red flag goes off for women. And when it gets above 300, that's when the red flag goes off for men.

It usually correlates with liver inflammatory activity. And there's some dysregulation, some stressor. It might be diet, it might be just environmental stress, it could be a number of factors ...

And I would argue [iron metabolism] is the most complicated, most sophisticated and least understood part of human physiology. It is not a dipstick function. Iron is not low or high. Iron is either dysregulated or it's functional. And if it doesn't have adequate supplies of copper, you don't have "functional" iron metabolism.

The fact is these two metals don't have separate metabolism. They are joined at the hip of the master antioxidant protein, Ceruloplasmin. That's what gives the metals their integrity. Ceruloplasmin expresses many enzymes but the most important ones are the ones that regulate iron and oxygen.

Copper's the only element on the planet that can manage the two most reactive elements in our body. All the others are kind of the observers, if you will. And so, copper is central to the process of keeping oxidative stress at a moderate level but optimizing energy production.

That's the magic sauce — making sure there's a healthy balance between energy and exhaust, just like there is in our car. We're going to produce exhaust. And so, it's like we've got to be able to optimize both the energy and the exhaust."

My Clinical Experience

I first became aware of the danger of excess iron over 30 years ago when I diagnosed my dad with hemochromatosis. His ferritin level was close to 1,000. I learned the danger of iron through health and science journalist and radio personality Bill Sardi, who recently passed away. Sardi had recommended an iron chelator called IP6, but I found it was worthless and the only thing that lowered my dad's ferritin was for him to do blood donations.

My dad had beta thalassemia, which predisposed him to iron accumulation. I inherited that from my father and my ferritin was also in the 100s in the 1980s. Thankfully, I have been relatively aggressive about lowering my iron through regular blood removal, but Robbins helped me understand that there is a huge gap here and we need to be hyperdiligent about keeping our iron levels low.

I used to measure serum ferritin on all my patients and nearly everyone was over 100, which is consistent with Robbins' observation that this is a major issue for nearly everyone. I used to regularly mention this in my newsletter but have neglected it in recent years. Thanks to Robbins, I now understand just how important this is and will be doing additional articles on how you can lower your iron.

Why Removing Iron Is so Important to Stay Healthy

I had read Robbins' book and listened to many of his interviews but never really appreciated the main crux of the problem of iron storage. What is typically taught is that you have 5,000 mg (5 grams) of iron in your body. But this number does NOT include iron stored in your tissues.

Robbins explains that we accumulate about 1 mg of iron every day (based on the research of leading Iron biologists), and unless we lose blood, we retain that amount. This is largely related to many of the processed foods being supplemented with dangerous forms of iron like iron fillings. So, by the time you are 65, you may have accumulated over 20,000 mg of storage iron.

This storage iron will radically increase the oxidative stress and tissue damage in your body. It also is one of the most common causes of fatigue because of how it impairs the mitochondrial production of energy.

When you donate a pint or half a liter of blood, you are actually removing 250 mg of iron from your tissue iron. Donating four pints a year is far more than most people do but you can see that if you had 20,000 mg of storage iron, it would take you 20 years of donating blood four times a year to get it down to normal levels.

Although blood donation is one highly effective way to lower your iron, it is not the ideal, as losing 10% of your blood in one sitting can be a problem for many. It is far easier on your system to remove blood in smaller amounts once a month on the schedule I have listed below. If you have congestive heart failure or severe COPD, you should discuss this with your doctor, but otherwise this is a fairly appropriate recommendation for most.

Men	150 ml
Postmenopausal Women	100 ml
Premenopausal Women	50 ml

Most Will Benefit From Blood Donation

As I mentioned above, most adult men and postmenopausal or nonmenstruating women, have excessive iron levels. Fortunately, there's a simple remedy. Simply donate blood one to four times a year. The more the better. However, four pints is an aggressive schedule and an easier approach to your system is to do it monthly at your home.

I will be doing a future video on this, but all it requires is hiring a phlebotomist to come to your house and drain the appropriate amount of blood as per the chart above. This could be pricey, but if you expand your network of family and friends you may be surprised that you already know someone who is a trained phlebotomist.

According to Robbins, people who donate blood a few times a year wind up living a lot longer because it reduces their iron and associated pathology. Can you imagine if you were donating the equivalent of four pints a year? In my view, it may be the single best way to improve your health.

Your body has no enzyme, no hormone, no active mechanism to address excess iron, other than blood loss, which allows it to leave your body. It's a profoundly basic principle. Robbins cites a famous iron biologist at Indiana University, the late Eugene D. Weinberg, who wrote an influential 2010 article in which he stated that at the first onset of not feeling well, he would donate a pint of blood and invariably feel better.

> *"What is aging?"* Robbins asks. *"It's iron accumulation in our eyes, in our hearing, in our hair, in our heart, our liver, our joints. All these conditions of old age are just iron accumulation. Why is it accumulating? Because it's not being recycled. And what's falling as we age? Critical minerals: magnesium drops, copper drops and retinol gets stored.*
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> *Retinol is not available in our metabolism. Why? Because it gets stuck in our liver because it's not being attached to the retinol binding protein, so it stays as retinyl esters in the liver and it has no function then.*
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> *The other connection that people need to know about is the connection between iron and sugar. There are two axes that run the body: Copper and fat, and iron and sugar, and never the twain shall meet ...*
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> *I've read a lot of articles. How many have I found that actually talk about the metabolism of fat in the mitochondria? One. And I think the mitochondria actually are fat organelles. They really prefer fat, but we've been corralled into a diet based on sugar, which is really toxic with iron. Most people don't know that. It's amazing what it does to the chemistry of the cell."*

Summary

To summarize some of the key points, ferritin can generally be used as a crude assessment tool for iron status, with the understanding that it's not reflective of intercellular iron stores, which is the more important parameter. So, if your ferritin is between 20 and 50, you're probably in the ballpark.

That said, Robbins warns that ferritin alone should never be used as an assessment of iron status. A far more powerful indicator is to measure your hemoglobin, as it's a bigger pool of iron and is constantly recycled. High hemoglobin would be suggestive of higher iron content.

If your ferritin is below 20, there may be some serious problems afoot, typically parasites. So, don't just jump to the conclusion that you have iron deficiency and start taking iron supplements, because iron is one of the most toxic supplements there is. Excessive iron is one of the easiest ways to destroy your health, and most of the iron added to processed foods are problematic as they can be carcinogenic.

> *"If people understand the importance of lowering the iron footprint and increasing the copper footprint, that produces this access to vitality and longevity that very few people talk about,"* Robbins says.

It is important to understand you still need to seriously consider depleting your high iron stores. The only ones who may be safe are those who have been regularly donating blood; probably donating over 20 pints would get you in the safe range.

As for raising your copper intake, it's best to get your copper from food and not a supplement. Good sources include bee pollen, grass fed beef liver and other organ meats. You also want plenty of saturated fats in your diet, as copper is a fat-soluble mineral. If you don't have fat in your diet, your ability to absorb copper plummets.

Whole food vitamin C can also be helpful, as vitamin C contains an enzyme called tyrosinase, which has 2 atoms of copper in it. Acerola cherry is one excellent source. A single acerola cherry contains about 80 mg of whole food vitamin C. Ascorbic acid is prooxidant, while vitamin C complex is actually an antioxidant. Anything that has copper is going to be antioxidant.

As noted by Robbins, "The antioxidant enzyme capacity is really dependent on available copper, so food-based forms are very important."

More Information

For more information, be sure to listen to the interview in its entirety, and pick up a copy of "**Cu-RE Your Fatigue: The Root Cause and How to Fix It on Your Own**." The book is available in paperback, ebook and audio. You can also learn more on his website, **TheRootCauseProtocol.com**.

> *"If people can just lower their iron footprint and increase their focus on nutrient dense food, with a special bias towards the copper, as we've discussed today, it's going to have a significant change in how your body generates energy, and how you feel,"* Robbins says. *"And if you want to get into the real depth of it, both the book and the website go into more detail."*

Sources and References

- [1, 2] The Root Cause Protocol, Morley Robbins
- [3] Antioxid Redox Signal. 2003 Oct; 5(5): 507–516