

Risk factors for Metabolic Syndrome

The overall prevalence in the United Kingdom is about 1 in 4 of the adult population but there are a number of higher risk populations

- Age – prevalence rises to 4 in 10 adults over 60
- Male sex
- Ethnicity – Asian and African Caribbean are higher risk
- Sedentary lifestyle
- Smoking
- Excess alcohol
- Sleep disturbance
- Some medications – particularly psychotropic drugs used to treat mental health disorders

Obesity - visceral versus subcutaneous fat and “TOFI”

It is central/abdominal i.e. visceral obesity that is the issue - visceral means around the organs hence the “spare tyre” effect. Visceral fat is far more metabolically active than fat under the skin (subcutaneous). It produces far more inflammatory proteins (cytokines) and is also much more prone to break down and rupture – ruptured fat cells promote inflammation. Consequently an increased waist circumference is the single best marker of metabolic syndrome. Body Mass Index (BMI) which is calculated by weight and height does not necessarily indicate where your fat is stored and also can be distorted by heavy muscle mass.

A small proportion of overweight people (probably less than 10%) do not appear to have any of the markers of metabolic syndrome and are not at increased risk of diabetes etc (they are however at higher risk of developing cancer and dying in accidents). Of greater concern is the fact that a substantial proportion of non-overweight people do in fact have abnormal metabolic markers and are at increased risk as a result. The acronym TOFI (Thin on the Outside, Fat on the Inside) is sometimes used to describe the phenomenon and it is important to be aware that not being overweight does not mean you can be complacent about poor lifestyle choices. People of Asian origin appear to be particularly at risk of this phenomenon.

Underlying Pathophysiology of Metabolic Syndrome

There appear to be two fundamental driving forces that cause metabolic syndrome

- **Insulin resistance**, and
- **Chronic inflammation**

These act synergistically (i.e. multiply their consequences) and trigger each other in a vicious cycle, hence inflammation promotes insulin resistance and the consequences of insulin resistance promote inflammation.

Understanding these two drivers clarifies the lifestyle factors that promote metabolic syndrome and identifies the changes that can be made to counter this. The good news is that most of the strategies that lower insulin resistance will lower inflammation and vice versa.

Understanding Fat Metabolism

Fat exists in the body in three primary forms: free fatty acids (FFAs), triglycerides and phospholipids. Triglycerides and phospholipids are the storage forms of fat. FFAs can be transported in the blood without any carriers.

In healthy people, FFAs are burned in the mitochondria soon after release (lipolysis) from storage forms of fat (triglycerides and phospholipids).

In metabolic syndrome, inflammation and oxidative damage impairs mitochondrial ability to burn fats. The excess FFAs then “spill over” into non-fat tissue like the liver, pancreas and skeletal muscles. FFAs damage these metabolically active tissues because they don't belong there. This is called lipotoxicity, which has been shown in several studies to cause insulin resistance and hence increase the risk of Type II Diabetes.

To complete the vicious cycle persistently high levels of glucose increase reactive oxidative damage to mitochondria!

Conventional Approaches to Metabolic Syndrome-

The standard medical approach is to address the consequences of metabolic syndrome individually e.g. a statin to lower cholesterol, diuretics to lower blood pressure, perhaps metformin to treat polycystic ovary syndrome. The problem with this approach is that, firstly it does not deal with the underlying processes causing metabolic syndrome so it “palliates” rather than treats. Secondly, the individual treatments aggravate other components of metabolic syndrome - hence statins raise insulin resistance, diuretics deplete the body of vital nutrients such as magnesium which raises insulin resistance and metformin depletes the body of essential vitamins such as B12 which has a powerful anti-inflammatory role.

If instead we understand and address inflammation and insulin resistance then metabolic syndrome can be reversed and the risks associated with it dissipated.



Insulin Resistance

When receptors are constantly exposed to high levels of insulin they down regulate and THEY BECOME RESISTANT TO INSULIN. This leads to a vicious cycle as blood glucose rises then insulin levels rise further leading to more stimulation, and then more resistance etc. When cells are constantly exposed to insulin, it eventually triggers the vicious cycle of rising insulin, and the consequences of this are complex. There are three problems that arise -

- The failure of cells to respond to insulin
- The different rates at which different organs/cell types become resistant to insulin - this means that some organs are overstimulated by the high insulin levels alongside other organs being resistant and hence under stimulated by insulin
- The need to metabolise/breakdown the high levels of insulin

1. Lack of response to insulin

When cells become resistant to insulin they are unable to efficiently take up glucose and magnesium for energy production. Protein synthesis is also dependent on insulin and hence for example insulin resistant muscle wastes away.

2. Harmful Actions of Insulin -

- Insulin increases fat storage – insulin increases the uptake of fat into cells, prevents the breakdown of fats in cells and stimulates the production of new fats from excess glucose.
- Insulin inhibits detoxification pathways in cells blocking the clearance of toxins.
- Insulin directly stimulates the sympathetic nervous system – this raises adrenaline and cortisol causing increased stress and high blood pressure. High levels of these hormones also worsen insulin resistance compounding the vicious cycle.
- Insulin is a growth factor – it directly promotes the formation of plaques in arteries and also is known to have “mitogenic” effects i.e. increases the risk of cancer cells developing.
- Insulin inhibits the excretion of sodium from the kidneys – this leads to raised blood pressure. This is accompanied by a reduction in the excretion of uric acid leading to raised blood levels. Uric acid is a very potent trigger of inflammation i.e. it has a harmful effect.

3. Dealing with High Levels of Insulin

- In the brain beta-amyloid clearance is reduced as the enzyme that clears this preferentially degrades insulin, hence part of the reason why high insulin increases Alzheimer's risk.

Not all tissue types become resistant at the same rate – the brain, liver and muscle cells tend to become resistant first. Hence you can have muscle weakness and wasting developing alongside cognitive decline but fat storage continues in adipose tissue. To compound this certain insulin dependent actions never become resistant to insulin - these include the stimulation of atherosclerosis, the switching off of detoxification and the retention of sodium by the kidneys. Hence these negative consequences are continuously driven by persistent high insulin levels.

Lowering Blood Glucose versus Lowering Insulin

Lowering insulin resistance will inevitably lead to a lowering of blood glucose but the reverse of this is not true - in fact many conventional drugs that are used to lower blood glucose actually raise insulin levels and aggravate insulin resistance.

Studies demonstrate that this in fact can lead to more harm than good - it is known that using insulin to control Type II diabetes increases death rates despite lowering glucose. It has also been shown that lowering blood glucose levels to as low as possible towards “normal” levels also increases death rates using conventional approaches.

If the impact of elevated insulin is considered then it is clear why any effective approach to lowering blood sugar must involve lowering insulin resistance.



Lowering Insulin Resistance

There are four key steps, each of which have a synergistic effect in lowering insulin resistance – diet, exercise, stress reduction and the use of herbs and supplements.

I. Dietary Approaches

There are two key strategies - lowering carbohydrate intake and fasting.

Lowering carbohydrate intake

There is still some debate as to whether a low fat diet is better than a low carbohydrate diet but logic tells us that from an insulin point of view carbohydrate has a much more significant impact on elevating insulin than eating fat. Fat ingestion does not raise insulin but carbohydrate clearly does and the lower the Glycaemic Load of your diet the less insulin response is required to assimilate your food. Conversely the higher your diet in refined or processed carbohydrates the worse the level of insulin resistance. This includes so called complex (starchy) carbohydrates if they are eaten in a processed form e.g. from wheat.

There are a number of ways to reduce your carbohydrate intake, but there is considerable variability in how different people respond to the same levels of carbohydrates so in the first instance take a simple approach to achieving a Low Carbohydrate Intake:

- Cut down the white stuff – remember starchy carbs are just concentrated sugar
- Cut out the sugar - that means cakes and biscuits are out
- All green vegetables/salads are fine – eat as much as you can. One good rule of thumb for vegetables is that those vegetables that you eat the part above the ground will have significantly lower carbohydrate (and higher healthful nutrients) than those that you eat the part below the ground
- Be careful with fruit - all berries are great, apples and pears too, but not tropical fruits like bananas, oranges, grapes, mangoes which are especially high in sugar
- Starchy carbohydrates such as wholegrains and potatoes should only be eaten in small amounts (wholemeal bread can raise blood sugar rapidly)

Fasting

In the modern “developed” world we have constant access to easy sources of food but this is not in accordance with our evolutionary history when we would likely have had considerable periods of fasting between eating. It takes most people 8-10 hours for their body to burn the sugar stored in the body as glycogen and it is not until you have used up your glycogen that your body starts to burn fat and insulin levels fall allowing the spiral of insulin resistance to be switched off – it appears most people hormonally switch from “fed” state to “fasted” state by 12 hours.

Many studies have shown that even after only a two-week intermittent fasting regime that insulin resistance falls and alongside this fat breakdown increases.

There are numerous ways to fast, these include –

- **Alternate day fasting** – this can in fact include an evening meal each day but on the fasting day this means you have gone nearly 24 hours since your last meal
- **5:2 diet** – restricted calories (usually 600 for men, 500 for women) on 2 days per week.
- **Shortened food window** – this involves eating your meals over a shortened time period each day

The simplest way to fast is to delay or skip breakfast – if you can delay eating for at least 12 hours since the last meal the day before then your body is already primed to start metabolising fat.

To contribute to this you should not eat your last meal of the day late – i.e. aim to eat your last meal at least 3 hours before sleeping - AND breaking your fast with the ubiquitous bowl of cereal will send you right back into metabolising carbohydrate and a raised insulin state!

Aiming for the 16:8 method (16 hours of not eating, 8 hours of eating during a day) is a great option as it is effective, becomes easy to do and does not require counting calories.

2. Exercise

Exercise is an effective way of lowering insulin resistance for two reasons. Firstly, building muscle and therefore increasing glycogen storage (by up to twenty times the amount!) so that more glucose can be taken out of the blood stream rapidly, avoiding spikes in blood sugar and hence spikes in insulin.

Secondly, by using up glycogen stores. This happens directly while exercising but more importantly exercise boosts your overall metabolic rate. During exercise it goes up as much as 10 times more than at resting rate AND the added advantage is that the metabolic rate will remain raised for up to 15 hours afterwards. This is very important because even if exercise is done regularly, people in sedentary jobs still spend the vast majority of the time not exercising.

Take a walk after eating

Studies have confirmed that exercising after eating with diabetes is better at reducing glucose raising effects than exercising the same amount before eating. Simply taking a stroll after eating raises metabolic rate and reduces glucose and insulin surges.

Stand up regularly

Having a sedentary lifestyle (i.e. prolonged sitting), EVEN IF people meet the current recommendation of 30 minutes of physical activity on most days each week, leads to potentially significant adverse metabolic and health effects and is an independent risk factor for metabolic syndrome.

Simply standing up and briefly moving is the key as the change in posture is the most powerful signal, i.e. rather than the standing up itself. This is important to understand because this means that we should interrupt sitting frequently, rather than doing lots of standing up in one go.

High Intensity Interval Training (HIIT)

HIIT is characterised by relatively short bursts of intense exercise with all-out, one hundred percent effort followed by short periods of rest/low exercise. For example running as fast as you can for 1 minute and then walking for 2 minutes or even fast

walking then strolling i.e. it is carried out according to your current fitness level. This form of exercise actually matches our evolutionary history far more than most other forms of exercise - as hunter gatherers there is lots of low level activity and then sudden bursts of extreme exercise – either as predator or to avoid becoming prey!

High intensity exercise uses “super-fast muscle fibres” which are 10 times faster than “slow fibres.” Activating super-fast fibres triggers Growth Hormone, which is associated with longevity and a reduction in insulin resistance.

3. Stress Reduction

Numerous studies show that perceived stress is an independent risk factor for developing Type II diabetes. Persistent stress leads to chronically high levels of the hormone cortisol and this directly opposes the action of insulin leading to rising blood glucose. There are numerous studies showing that stress reduction reverses this and leads to lower insulin resistance.

There are a number of ways of reducing stress without necessarily involving financial and time expensive means.

Progressive Relaxation

This is a simple technique of relaxing the body by bringing our awareness to it. In the course of daily life chronic tension builds up without conscious awareness and it is only when we draw our attention to our body that we can tune in and release this tension. Tension arises as a basic response to prepare our bodies for potentially dangerous situations but this also feeds back to our mind that we should be on the alert – a relaxed mind cannot exist easily in an unrelaxed body.

In progressive muscle relaxation exercises you tense up particular muscles and then relax them, aiming to work progressively all of the way through the different parts of the body so that ultimately all muscle groups are involved.



4. Nutrients

There are literally hundreds of herbs and supplements that may be relevant for insulin resistance. It is important to be sure that they do not lower blood glucose simply by stimulating insulin release as this can compound the problem of insulin resistance. The supplements described below are some of the options with the strongest evidence of benefit but this is by no means an exhaustive list.

Chromium GTF (Glucose Tolerance Factor)

Chromium is a mineral with a history of use in diabetes going back more than 50 years when it was first identified as being a vital addition for patients receiving intravenous nutrition who otherwise developed diabetes and insulin therapy was ineffective.

Eating processed foods, including simple sugars, makes chromium deficiency an increasing problem because these foods are low in chromium and they also make you lose additional chromium.

Chromium increases sensitivity to insulin by increasing insulin binding to cells, increasing the number of insulin receptors on cells and activating insulin receptor enzymes.

Organic forms give the best results as they are substantially more “bioavailable”. Only 1% or less of inorganic chromium is absorbed compared to 10-25% of chromium GTF. It also reduces blood glucose by 16.8% compared to 6.0% for inorganic chromium i.e. 2.8 times more effective.

Chromium picolinate, which is a commonly used form, enters living cells via a different mechanism to naturally formed Food State chromium (such as GTF) and there is evidence that it increases the production of harmful free radicals and has been shown in test tube studies to damage DNA.

Cinnamon

Cinnamon has been used for centuries as an anti-diabetic spice and has three distinct actions:

- **Slowing glucose absorption from GI tract** – it inhibits certain digestive enzyme from the pancreas and so slows down the rate of absorption of sugars from a meal.
- **Insulin mimetic** – compounds in cinnamon mimic the effect of insulin. This means it can be particularly useful in the later stages of Type II with pancreatic exhaustion leading to less insulin.
- **Improving insulin sensitivity** – it can improve sensitivity to insulin by a factor of up to 20 times.
- **Alternate day fasting** – this can in fact include an evening meal each day but on the fasting day this means you have gone nearly 24 hours since your last meal

There are two main subspecies of Cinnamon - *Cinnamomum cassia* (Chinese cinnamon) and *Cinnamomum zeylonica* (Ceylon Cinnamon or True Cinnamon).

The spice most likely found in the kitchen and by far the most commonly used, is the cheaper *cassia* but this sub-species contains high amounts of coumarins! Warfarin in rat poison is a coumarin and European regulations now insist on much reduced daily upper limit of *Cassia* cinnamon. Ceylon cinnamon contains 1,250 LESS coumarin than *Cassia* making it much safer.

Magnesium

Magnesium is the fourth most prevalent mineral in the body and deficiency occurs in up to 80% of the population. Magnesium has been shown to reduce fasting glucose and insulin resistance as insulin requires magnesium to act effectively. Importantly magnesium entry into cells requires insulin to be acting effectively so inadequate magnesium intake prompts a vicious cycle of low magnesium levels causing insulin resistance leading to lower magnesium uptake etc.

Zinc

Zinc is a widely used and very important element. Zinc stabilises insulin so that it binds to cell receptors more effectively which allows insulin to act more efficiently on cells. Zinc also has a role to play in numerous enzymes in your body – including insulin degrading enzyme. IDE is required to break down insulin and insufficient levels have been shown to increase insulin resistance particularly in the brain, with a particular role in dementia development.

Vitamin D

Vitamin D is a steroid hormone with almost countless roles to play in the body and deficiency is widespread due to fear of sun exposure and a reduction in the consumption of higher fat foods that naturally contain vitamin D. Low levels have been shown to be associated with increased insulin resistance and more importantly appropriate supplementation has been shown to reduce insulin resistance.



Type II Diabetes and Metabolic Syndrome - some clarification.

As outlined previously, there is some debate as to what is the most appropriate term to use to describe metabolic syndrome. It is important to be aware that the exact definition of cut off points for any particular metabolic disorder/disease is arbitrary. Diabetes happens to be defined at a certain level of raised blood glucose but there is no magical level at which a raised sugar suddenly becomes harmful. There are known risks associated with raised insulin and raised glucose considerably lower than the levels defined as diabetic.

Additionally in type II diabetes it is important not to simply be obsessed with dealing with raised glucose, because the vast majority of people with type II diabetes have all the additional metabolic features of metabolic syndrome. Hence the advice and information given with regard to metabolic syndrome applies to type II diabetes. It is in fact even more important as type II diabetes can be considered a severe form of metabolic syndrome.

Inflammation

The importance of inflammation cannot be overstated – inflammation alone directly contributes to every single metabolic dysfunction associated with metabolic syndrome including leptin resistance (leptin has a vital role controlling appetite), impaired fat and glucose metabolism and insulin resistance. ***In fact the level of inflammation in the body (as measured by a protein called CRP) is the single best predictor of bad outcomes (including death) in type II diabetes regardless of sugar control, blood pressure control and cholesterol levels.***

Causes of Inflammation –

- Insulin resistance
- Dietary sensitivity/allergy – IgG not IgE
- Adiposity
- Toxins
- Processed foods
- Stress

Lowering Inflammation

The good news is that most of the interventions that are outlined to prevent/reverse insulin resistance will also lower inflammation, and indeed are a vital part of addressing high inflammation levels. There are a few other points to emphasise with respect to diet and supplements.

Additional dietary changes

Reduce Omega-6 Intake

Omega-6 and omega-3 fatty acids are both essential i.e. they must be ingested as the body cannot manufacture them. However they compete to make hormones and other chemicals in the body and when the ratio of omega 6 : omega 3 is high this prompts inflammatory pathways. Modern diets can have a ratio as high as 20:1 whereas ideally the ratio should be as near equal as possible. Grains, sunflower oil, corn oil, margarine and processed foods are particularly high in omega-6 fatty acids.

Avoid Trans-Fats

Trans-fats (also known as partially hydrogenated oils) were developed to make vegetable oils last longer and spoil less frequently than animal fats. By the 1960s trans-fats had replaced almost all animal fats (lard) in commercial foods such as baked goods and they are used for frying in most commercial situations. Trans-fats have been shown to increase inflammation and are strongly linked to increased disease. For this reason many countries have banned their use BUT there is no evidence that the alternatives being used are in fact any safer, which is a message that any processed foods should be treated with caution.

Identify food intolerances

In theory this could include any food substance and this is not restricted to immediate allergic reactions, such as peanut allergy, but rather more slowly acting allergic/inflammatory cascades that are set up by certain foods. In practice the best way to establish this is an elimination diet removing potential causes for 3-4 weeks and then carefully reintroducing them. In practical terms there are two food types

that are by far the most common sources of problems and these are wheat and cow's milk. Having intolerance to both is not at all unusual.

Avoid simple sugars in particular fructose

This goes along with lowering the glycaemic load of the diet but additionally it is important to emphasise the pro-inflammatory effects of fructose, despite fructose not affecting glycaemic load. Fructose intake is linked to liver inflammation and in particular elevates uric acid which is a very strong indicator of inflammation.



Reduce
Omega-6 Intake



Avoid Trans-Fats



Identify food intolerances



Further Supplements

Curcumin

Curcumin is the active ingredient of turmeric, there are also small amounts in ginger. Black Pepper (piperine) greatly enhances absorption. Curcumin has been shown to have powerful anti-inflammatory effects including in fat cells and to reduce CRP, insulin resistance and leptin resistance.

Krill Oil

Krill oil is high in the two fatty acids (EPA and DHA) that underlie the benefits of fish oil including its anti-inflammatory effect. These are considerably better absorbed from krill oil than fish oil.

Krill oil also contains phosphatidylcholine which is an essential neurotransmitter precursor important to brain and muscle tissue. Phosphatidylcholine participates in fatty acid transport in the blood and across membranes.

Krill oil also contains astaxanthin a carotenoid molecule with powerful antioxidant activity and which is protective to the lining of all blood vessels and also to the tissue of the retina. It has a number of other anti-inflammatory and antioxidant health benefits.



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RELEVANT CYTOPLAN PRODUCTS

Multivitamin and mineral formulae

To maintain healthy metabolism – address the basics first with all-round nutritional support. Due to the 'nutrition gap' a multi is recommended to provide a foundation for health. For example, B vitamins for methylation and energy production; vitamin C for support of adrenal hormone production; vitamin D for anti-inflammatory and insulin resistance benefits; vitamin E for anti-oxidant effects; trace minerals that act as enzyme co-factors including zinc important for protein synthesis and stabilising insulin levels.

This is a selection from our range of multiformulae; all are vegan.

Foundation Formula 1 – a food state 1-2 a day multivitamin and mineral containing good levels of all nutrients. This formula is also available without iron which is therefore more suitable for postmenopausal women and men (Foundation Formula 2).

Wholefood 50+ – a comprehensive wholefood multi with higher levels of B vitamins, vitamins C and D and trace minerals. Also contains the antioxidant coenzyme Q10; this antioxidant is produced in the body however level decrease with age (and it is depleted by statin medication).

Alternative products:
Foundation Formula 2,
Wholefood Multi,
Family Formula,
Cyto-Gold,
Cytoplex and Little People



Vitamins and Minerals

Blood Glucose Support can be taken alongside a multivitamin/mineral formula. It contains key nutrients to support healthy uptake of glucose into cells, including chromium and cinnamon which have been shown to reduce carbohydrate craving and chromium is an important component of glucose tolerance factor (GTF). Zinc and magnesium are also present, both of which have been shown to improve insulin sensitivity and magnesium assists the uptake of glucose. The plant base also naturally contains beneficial minerals selenium, copper and molybdenum.

Contraindications: Diabetics who are taking insulin should consult with their doctor before taking this product.

Biofood Magnesium is an organic matrix form of magnesium complete with natural amino acid carriers to ensure transport to sites of need within the body. Is important for energy production and has been shown to reduce insulin resistance as well as fasting glucose levels.

Alternative product: Magnesium Citrate

Vitamin D3 62.5 µg & 15 µg – higher and lower potency formulas are available. The high potency formula can be taken alongside one of our multis to boost levels for a short period of time (e.g. for a few months or over the winter). The lower dose formula is suitable for children or to take all year round in conjunction with a multi. As vitamin D is fat soluble, it is best taken with a fat containing meal (i.e. main meal). Our vitamin D is sourced from lichen and is thus suitable for vegans. Low levels of vitamin D have been shown to increase risk of insulin resistance.



Fatty Acids

Krill Oil – contains the omega 3 fatty acids EPA and DHA. The omega fatty acids in Krill are presented attached to phospholipids which help absorption of the omega 3 fatty acids in Krill oil; they are thus better absorbed compared to fish oil. Krill also provides the added benefit of being naturally rich in astaxanthin a powerful antioxidant.

Omega-3 Vegan provides DHA and EPA from a marine algal source. It is therefore suitable for vegetarians and vegans who may find it difficult to obtain sufficient omega-3 fatty acids from their diet.

Alternative products: High potency fish oil capsules, Lem 0-3, Organic flaxseed oil, Golden Phospholec (soya lecithin)

Other products

Phyte-Inflam is a combination of curcumin, ginger and piperine which collectively bestow a wide range of anti-inflammatory properties. *Contraindications: If taking prescribed medications check for potential interactions.*

Adrenal Support contains a unique herbal blend of Siberian and Chinese Ginseng, Suma Root, Tienchi Root and Liquorice that may support healthy adrenal function. Also contains Pantothenic Acid (B5) to improve the body's ability to withstand stressful conditions. As well as nutrients such as selenium, iodine, chromium to contribute to normal thyroid and carbohydrate metabolism function.

Methyl Factors – a formula designed to provide methyl donor nutrients to help those with elevated homocysteine and other conditions that occur as a result of impaired methylation.

Alternative products: Methylfolate, B12 methylcobalamin, B12 hydroxycobalamin



Live bacteria

Research has demonstrated the benefits of probiotics in reducing insulin resistance, lowering blood glucose, lowering blood pressure and reducing inflammation.

Acidophilus Plus – contains 9 strains of live bacteria. All our Live Bacteria products are grown on molasses and thus are suitable for vegans.

Alternative products: Fos-A-Dophilus, Cytobiotic Active, Saccharomyces Boulardii



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Cytoplan celebrates 26 years in the field of food-based supplementation and from the moment of conception to the present day we have promoted the philosophy that nutrients are best delivered to the body "in the same form as food".

The philosophy and message of Cytoplan was founded on the simple logic that our bodies are designed to eat food and utilise its components for the maintenance of life. The ultimate goal of Cytoplan is to 'improve the health of the nation' by supplying supplements in a bio-effective form for optimal absorption and utilisation.



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