**Mastering Glutathione: Empowering Healthcare Providers with Knowledge of its Function and Clinical Applications**



---

Glutathione, often referred to as the "master antioxidant," is a vital molecule that plays a crucial role in maintaining cellular health and protecting the body against oxidative stress. As healthcare professionals, it is important to have a deep understanding of the mechanisms of glutathione and its impact on overall health and well-being. Glutathione is well-regarded as a natural, potent antioxidant. When we are in a youthful state of good health the amount of glutathione and other antioxidants is sufficient to balance the free radicals that are routinely generated. However as we age, or at times of illness or stress, adding glutathione can help to neutralize the free radical overload

What is Glutathione?

Glutathione is a tripeptide composed of three amino acids: cysteine, glycine, and glutamate. It is naturally produced in the body and is found in every cell. Glutathione acts as a powerful antioxidant, neutralizing free radicals and protecting cells from damage. It also supports various biochemical processes, including DNA synthesis, protein synthesis, and detoxification.

Antioxidant Activity

One of the primary roles of glutathione is its antioxidant activity. It works by scavenging free radicals, which are unstable molecules that can cause damage to cells and DNA. Glutathione helps to regenerate other antioxidants like vitamins C and E, enhancing their effectiveness in neutralizing harmful free radicals.

Detoxification Support

Glutathione is a key player in the body's detoxification processes. It binds to toxins, heavy metals, and harmful substances, facilitating their removal from the body. Glutathione also supports the liver in its role of detoxification by aiding in the breakdown and elimination of harmful compounds.

Immune Function

Glutathione plays a critical role in supporting a healthy immune system. It helps to enhance the function of immune cells, such as T cells and natural killer cells, which are responsible for fighting off infections and cancer cells. Glutathione also helps regulate the production and activity of cytokines, which are important signaling molecules in the immune system.

## Cellular Energy Production

Glutathione is involved in cellular energy production by supporting the function of mitochondria, the powerhouses of cells. It participates in the electron transport chain, a series of biochemical reactions that generate adenosine triphosphate (ATP), the primary energy currency of cells. Adequate levels of glutathione are essential for optimal cellular energy production and overall vitality.

## Aging and Age-Related Conditions

As we age, the levels of glutathione in the body naturally decline. This decrease in glutathione has been linked to various age-related conditions, including neurodegenerative diseases, cardiovascular diseases, and impaired immune function. Supplementing with glutathione or its precursors may help support healthy aging and reduce the risk of age-related diseases.

## Glutathione and Disease States

Numerous studies have highlighted the potential therapeutic benefits of glutathione in various disease states. It has been investigated for its role in managing conditions such as chronic fatigue syndrome, Parkinson's disease, Alzheimer's disease, liver diseases, and respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD). Further research is needed to explore the full extent of glutathione's therapeutic potential.

## Glutathione and Neurological Health

Emerging research suggests that glutathione may play a crucial role in maintaining neurological health. Studies have found associations between glutathione levels and neurodegenerative conditions such as Alzheimer's disease, Parkinson's disease, and multiple sclerosis. Glutathione's antioxidant properties help protect brain cells from oxidative stress, while its role in detoxification supports the removal of neurotoxic substances. Further investigations are underway to explore the therapeutic potential of glutathione in preserving brain function and preventing or managing neurological disorders.

## Glutathione and Skin Health

Glutathione has gained attention for its potential benefits in promoting skin health and appearance. It is involved in maintaining skin elasticity, reducing oxidative damage caused by ultraviolet (UV) radiation, and regulating pigment production. Some individuals use glutathione supplementation or topical application for skin brightening and to address concerns such as hyperpigmentation, acne, and signs of aging. While more research is needed to fully understand its effects on skin health, glutathione shows promise as a supportive element in skincare routines.

## Optimizing Glutathione Levels

Given the importance of glutathione in maintaining overall health, strategies to optimize its levels are of interest. While direct glutathione supplementation is available, it is worth noting that oral supplementation may have limited absorption and availability. Alternative approaches include supporting the body's natural glutathione production through lifestyle modifications, such as regular exercise, stress management, adequate sleep, and a nutrient-rich diet. Consuming foods rich in glutathione precursors, such as sulfur-containing vegetables (e.g., broccoli, garlic, onions), cruciferous vegetables, and whey protein, can also support glutathione synthesis. Healthcare professionals can guide individuals in adopting lifestyle habits and dietary choices that promote optimal glutathione levels.

## Oral Absorption

N-acetylcysteine (NAC) is a precursor to glutathione, a powerful antioxidant produced naturally by the body. While both NAC and glutathione have been studied for their potential health benefits, there is evidence to suggest that taking NAC orally may be more effective than directly supplementing with glutathione.

Oral NAC supplementation has been shown to increase glutathione levels in various tissues and provide antioxidant support. NAC is readily absorbed in the gastrointestinal tract and can effectively deliver cysteine, a key component for glutathione synthesis, to the body's cells.
On the other hand, oral supplementation with glutathione itself may not be as efficient in increasing cellular glutathione levels. Glutathione can be broken down during digestion, and its bioavailability is limited. Studies have shown that glutathione is rapidly degraded by enzymes in the gut, leading to minimal absorption and availability for cellular utilization. Administering glutathione orally is unlikely to have value. Studies evaluating a 3 g oral dose demonstrated no increased glutathione concentrations. A more reliable approach is to supplement with NAC which can help to increase glutathione synthesis.

## Crossing the Blood Brain Barrier

Glutathione, a powerful antioxidant produced naturally in the body, has been found to play a crucial role in brain health. One of its notable benefits is its ability to cross the blood-brain barrier.

Studies have shown that glutathione supplementation can increase brain glutathione levels, supporting optimal brain function and protecting against oxidative stress, a condition referred to as "neuroinflammation.". Glutathione's presence in the brain is essential for various neurological processes, including neurotransmitter regulation, detoxification, and maintenance of neuronal health.  It may be helpful in neurodegenerative conditions such as Parkinson's, Alzheimer's, as well as in neuropsychiatric conditions.

## Half-life of Glutathione

The half-life of glutathione, a critical antioxidant in the body, is relatively short. Studies have shown that the plasma half-life of glutathione ranges from a few minutes to about one hour. This short half-life is primarily due to its rapid utilization in various cellular processes and interactions with reactive oxygen species.

When it is stored in a vial it remains stable until it is injected. In the circulation it has a half-life of approximately 10 minutes. Therefore rapid intravenous infusion, or intravenous push are recommended.

## Compatibility with Other Micronutrients

Glutathione, being a sensitive molecule, can undergo degradation or breakdown when mixed with certain other micronutrients. This is particularly true when exposed to heat, light, or certain enzymes. Therefore, it is important to handle and store glutathione properly to maintain its integrity and effectiveness.

To ensure optimal absorption and utilization of glutathione, it is recommended to give it separately from other micronutrients. This allows for better bioavailability and prevents potential interactions that may compromise its stability.

## The role of Glutathione in Cancer

Glutathione, a powerful antioxidant and detoxifying agent, plays a crucial role in cancer prevention and treatment. It helps protect cells from oxidative stress, supports immune function, and promotes detoxification of harmful substances. Glutathione also has a significant impact on cellular processes involved in cell growth, division, and programmed cell death (apoptosis).
Studies have shown that cancer cells often exhibit lower levels of glutathione compared to normal cells, suggesting that glutathione depletion may impair their survival and growth. By modulating glutathione levels, it is possible to enhance the effectiveness of chemotherapy and radiation therapy while reducing their side effects.

Furthermore, glutathione has been found to possess anti-inflammatory properties, which can help mitigate chronic inflammation, a known risk factor for cancer development.

Glutathione should never be given at the same time as high-dose vitamin C. Its antioxidant activity can weaken the benefit of pro-oxidative vitamin C Infusions. The same applies to glutathione given concurrently with chemotherapy or radiation.

For more details, and specific protocols, see the course on vitalized health and on infusion-based cancer therapy.

Glutathione should never be given at the same time as high-dose vitamin C. Its antioxidant activity can weaken the benefit of pro-oxidative vitamin C Infusions. The same applies to glutathione given concurrently with chemotherapy or radiation.

For more details, and specific protocols, see the course on Cancer Therapy on Intellectual Medicine University and on infusion-based cancer therapy.

## Glutathione in Asthma Patients

Glutathione is a powerful antioxidant that plays a crucial role in supporting respiratory health and reducing oxidative stress in the body. For individuals with asthma, it may offer potential benefits in managing symptoms and improving overall lung function. Studies have shown that glutathione supplementation can help reduce airway inflammation, enhance antioxidant defenses, and improve lung function parameters in individuals with asthma.

## Glutathione and Sulfa Allergy

Glutathione, a naturally occurring antioxidant in the body, is often misunderstood to be related to sulfonamides or sulfa drugs. However, it is important to note that glutathione and sulfonamides are chemically distinct compounds, and having a sulfa allergy does not necessarily indicate an allergy to glutathione.

Glutathione is composed of three amino acids: cysteine, glutamate, and glycine, and does not contain any sulfur-sulfonamide bonds that are characteristic of sulfa drugs. Therefore, individuals with a documented sulfa allergy can generally tolerate glutathione without experiencing an allergic reaction.

In summary, understanding the mechanisms and benefits of glutathione is crucial for healthcare professionals seeking to support their patients' overall health and well-being. Glutathione's roles as an antioxidant, detoxifier, immune modulator, energy booster, and potential therapeutic agent in various conditions make it an intriguing molecule with multifaceted implications. By staying abreast of the latest research and incorporating this knowledge into clinical practice, healthcare professionals can provide comprehensive care and explore the potential of glutathione-based interventions.

## How fast pushed

Before or after the infusion

References:


1. Johnson WM, Wilson-Delfosse AL, Mieyal JJ. Dysregulation of glutathione homeostasis in neurodegenerative diseases. Nutrients. 2012 Oct 9;4(10):1399-440. doi: 10.3390/nu4101399. PMID: 23201762; PMCID: PMC3497002.
2. Kannan R, Kuhlenkamp JF, Jeandidier E, Trinh H, Ookhtens M, Kaplowitz N. Evidence for carrier-mediated transport of glutathione across the blood-brain barrier in the rat. J Clin Invest. 1990 Jun;85(6):2009-13. doi: 10.1172/JCI114666. PMID: 1971830; PMCID: PMC296671.
3. Zhu S, Makosa D, Miller B, Griffin TM. Glutathione as a mediator of cartilage oxidative stress resistance and resilience during aging and osteoarthritis. Connect Tissue Res. 2020 Jan;61(1):34-47. doi: 10.1080/03008207.2019.1665035. Epub 2019 Sep 15. PMID: 31522568; PMCID: PMC6884680.
4. Sonthalia S, Daulatabad D, Sarkar R. Glutathione as a skin whitening agent: Facts, myths, evidence and controversies. Indian J Dermatol Venereol Leprol. 2016 May-Jun;82(3):262-72. doi: 10.4103/0378-6323.179088. PMID: 27088927.
5. Ballatori N, Krance SM, Notenboom S, Shi S, Tieu K, Hammond CL. Glutathione dysregulation and the etiology and progression of human diseases. Biol Chem. 2009 Mar;390(3):191-214. doi: 10.1515/BC.2009.033. PMID: 19166318; PMCID: PMC2756154.
6. Gu F, Chauhan V, Chauhan A. Glutathione redox imbalance in brain disorders. Curr Opin Clin Nutr Metab Care. 2015 Jan;18(1):89-95. doi: 10.1097/MCO.0000000000000134. PMID: 25405315.
7. Pizzorno J. Glutathione! Integr Med (Encinitas). 2014 Feb;13(1):8-12. PMID: 26770075; PMCID: PMC4684116.
8. Han C, Someya S. Maintaining good hearing: calorie restriction, Sirt3, and glutathione. Exp Gerontol. 2013 Oct;48(10):1091-5. doi: 10.1016/j.exger.2013.02.014. Epub 2013 Feb 20. PMID: 23454634; PMCID: PMC3759555.
9. Richie JP Jr, Leutzinger Y, Parthasarathy S, Malloy V, Orentreich N, Zimmerman JA. Methionine restriction increases blood glutathione and longevity in F344 rats. FASEB J. 1994 Dec;8(15):1302-7. doi: 10.1096/fasebj.8.15.8001743. PMID: 8001743.
10. Eum KD, Wang FT, Schwartz J, Hersh CP, Kelsey K, Wright RO, Spiro A, Sparrow D, Hu H, Weisskopf MG. Modifying roles of glutathione S-transferase polymorphisms on the association between cumulative lead exposure and cognitive function. Neurotoxicology. 2013 Dec;39:65-71. doi: 10.1016/j.neuro.2013.08.002. Epub 2013 Aug 16. PMID: 23958642; PMCID: PMC3844089.
11. Eum KD, Wang FT, Schwartz J, Hersh CP, Kelsey K, Wright RO, Spiro A, Sparrow D, Hu H, Weisskopf MG. Modifying roles of glutathione S-transferase polymorphisms on the association between cumulative lead exposure and cognitive function. Neurotoxicology. 2013 Dec;39:65-71. doi: 10.1016/j.neuro.2013.08.002. Epub 2013 Aug 16. PMID: 23958642; PMCID: PMC3844089.
12. Wendel A, Cikryt P. The level and half-life of glutathione in human plasma. FEBS Lett. 1980 Nov 3;120(2):209-11. doi: 10.1016/0014-5793(80)80299-7. PMID: 7439398.
13. Atkuri KR, Mantovani JJ, Herzenberg LA, Herzenberg LA. N-acetylcysteine—a safe antidote for cysteine/glutathione deficiency. Curr Opin Pharmacol. 2007 Aug;7(4):355-9.
14. Witschi A, Reddy S, Stofer B, Lauterburg BH. The systemic availability of oral glutathione. Eur J Clin Pharmacol. 1992;43(6):667-9.
15. Rushworth GF, Megson IL. Existing and potential therapeutic uses for N-acetylcysteine: the need for conversion to intracellular glutathione for antioxidant benefits. Pharmacol Ther. 2014 Apr;141(2):150-9.
16. Ritchie HE, Reid MD, Auchterlonie IA, Kay AR. Glutathione—A Review of Its Role and Efficacy in Aesthetic Medicine and Dermatology. J Clin Aesthet Dermatol. 2019 Feb;12(2):E39-E44.

17. Dringen R. Metabolism and functions of glutathione in brain. Prog Neurobiol. 2000 Aug;62(6):649-71.
18. Pocernich CB, Butterfield DA. Elevation of glutathione as a therapeutic strategy in Alzheimer disease. Biochim Biophys Acta. 2012 Jun;1822(5):625-30.
19. Holmström KM, Finkel T. Cellular mechanisms and physiological consequences of redox-dependent signalling. Nat Rev Mol Cell Biol. 2014 Apr;15(6):411-21.
20. Hauser PS, Narayanasamy P, Ryan RO. Effect of glutathione on the binding and uptake of apolipoprotein E-containing high-density lipoprotein by HepG2 cells. Biochim Biophys Acta. 2002 Nov 15;1580(1):15-22.
21. Pfeiffer CM, Huff DL, Gunter EW. Rapid and Accurate HPLC Assay for Plasma Total Homocysteine and Cysteine in a Clinical Laboratory Setting. Clin Chem. 1999 Nov;45(11):290-2.
22. Traverso N, et al. Role of glutathione in cancer progression and chemoresistance. Oxid Med Cell Longev. 2013;2013:972913.
23. Menon SG, et al. Glutathione-mediated therapy for lung cancer: Challenges and opportunities. Oxid Med Cell Longev. 2017;2017:2497340.
24. Ahsan H. 8-Hydroxydeoxyguanosine: A DNA adduct marker of oxidative stress and cancer risk. Oxid Med Cell Longev. 2019;2019:3616874.
25. Kelly FJ, et al. Asthma, allergy, and oxidant stress induced by environmental pollutants. Toxicol Pathol. 2007;35(1):147-166.
26. De Rosa SC, et al. N-acetylcysteine replenishes glutathione in HIV infection. Eur J Clin Invest. 2000;30(10):915-929.
27. Lomaestro BM, et al. Sulfa allergy: cross-reactivity versus multiple drug hypersensitivity. Am J Med. 1999;107(6): 588-591.
28. Meister A, Anderson ME. Glutathione. Annu Rev Biochem. 1983;52:711-60.
29. Ballatori N, Krance SM, Notenboom S, et al. Glutathione dysregulation and the etiology and progression of human diseases. Biol Chem. 2009 Dec;390(3):191-214.
30. Lu SC. Regulation of glutathione synthesis. Mol Aspects Med. 2009 Feb-Apr;30(1-2):42-59.
31. Anderson ME. Glutathione: an overview of biosynthesis and modulation. Chem Biol Interact. 1998 Jul 24;111-112:1-14.
32. Wu G, Fang YZ, Yang S, et al. Glutathione metabolism and its implications for health. J Nutr. 2004 Mar;134(3):489-92.