

## Corporate Medical Policy

### Intracellular Micronutrient Analysis AHS – G2099

**File Name:** intracellular\_micronutrient\_analysis  
**Origination:** 01/2019  
**Last Review:** 04/2023

#### Description of Procedure or Service

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Micronutrients are dietary components, often referred to as vitamins and minerals, which although only required by the body in small amounts, are vital to development, disease prevention, and wellbeing. Micronutrients are not produced in the body and must be derived from the diet (CDC, 2015; Life, 2012). Micronutrients include essential trace elements such as boron, iron, zinc, selenium, manganese, iodine, copper, molybdenum, cobalt, and chromium (Frieden, 1985; WHO, 1973), and essential vitamins such as vitamins A, B, C, D, and K (organic) (Giddeen & Shenkin, 2000).

**\*\*\*Note: This Medical Policy is complex and technical. For questions concerning the technical language and/or specific clinical indications for its use, please consult your physician.**

#### Policy

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**Reimbursement for Intracellular Micronutrient Analysis is not allowed**

#### Benefits Application

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This medical policy relates only to the services or supplies described herein. Please refer to the Member's Benefit Booklet for availability of benefits. Member's benefits may vary according to benefit design; therefore member benefit language should be reviewed before applying the terms of this medical policy.

#### When Intracellular Micronutrient Analysis is covered

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Not applicable.

#### When Intracellular Micronutrient Analysis is not covered

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Reimbursement is not allowed for intracellular micronutrient panel testing (e.g., SpectraCell, Cell Science Systems cell micronutrient assay, ExaTest) for all applications.

#### Policy Guidelines

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##### Table of Terminology

Term	Definition
ASEM	Analytical scanning electron microscopy
CDC	The Centers for Disease Control
CLIA	Clinical Laboratories Improvement Amendments

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CLIA '88	Clinical Laboratory Improvement Amendments of 1988
CMA	Cellular micronutrient assay
CMS	Centers for Medicare and Medicaid
CSS	Cell Science Systems
EXA	Energy dispersive x-ray analysis
FDA	Food and Drug Administration
HPLC	High-performance liquid chromatography
LDTs	Laboratory-developed tests
SI	Stimulation index
WHO	World Health Organization

## **Background**

Micronutrients, such as zinc, selenium, and copper, are involved in metabolic processes, either as catalysts or facilitators for various enzymatic functions. Micronutrient deficiency can result from general malnutrition, a current illness, or side effects of medications or procedures. Nutritional loss may exacerbate severe illness and side effects of medications as the inflammatory response draws micronutrients to the damaged organs, causing an increase in oxidative stress, and normal defense mechanisms to fail (Preiser et al., 2015). For example, oxidative damage in copper deficiency results in muscle weakness and edema, and impaired oxidative status in iodine deficiency leads to a decrease in thyroid hormone synthesis and mental retardation (Pazirandeh, 2022; Pearce et al., 2016).

The measurement of serum vitamin and mineral levels is widely available from numerous commercial testing companies. Normal serum nutrient concentration varies based on its function in the body. Serum concentrations of nutrients involved in regulatory mechanisms, such as calcium and zinc, are maintained within narrow ranges regardless of body stores and any changes only occur with severe nutrient deficiency. Other nutrients, such as carotenoids, vary in the body depending on recent intake or half-life length. Environmental factors, such as infections or stress, can also influence serum nutrient concentrations. Vitamin C, Vitamin B, selenium, and magnesium play a role in reducing the levels of cortisol and adrenalin in the body (McCabe et al., 2017). Nutrient concentrations may also vary based on the tissue. Nutrient concentrations in cell membranes or bone fluctuate less, but these measurements are more difficult to obtain (Elmadfa & Meyer, 2014). Serum nutrient testing is promoted to the public as a nutrient deficiency screening and supplement personalization, but these tests are usually unwarranted. There is not enough information available regarding the optimal blood levels of vitamins. Moreover, there is a lack of evidence that vitamin supplements prevent disease in healthy adults with low blood levels of vitamins, apart from those with specific diets or conditions. Vitamin deficiencies typically occur in special populations such as the elderly or those with gastric bypass surgery, and not the general public (Fairfield, 2022).

Another possible method of measuring nutrient deficiency is to assess the intracellular concentration (as opposed to the typical serum measurement). Intracellular micronutrient lymphocyte analysis was developed based on the premise that a peripheral blood lymphocyte reflects the genetic and biochemical state of the person at the time it was formed (Shive et al., 1986).

## ***Proprietary Testing***

Lymphocyte measurement is the basis of SpectraCell's micronutrient testing procedure. Lymphocytes are isolated from the blood sample and placed in a culture medium containing the optimal levels of nutrients for sustained growth. A given micronutrient is removed, and then growth is measured and compared against the 100% level of growth. For example, Vitamin B6 may be removed from the medium. The growth rate of the cell is theoretically only dependent on vitamin B6

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as all other micronutrients are at optimal levels; therefore, any deficiency in cell growth would be caused by issues with intracellular Vitamin B6. This is done for all 31 micronutrients in the panel and results are reported. The micronutrients included in SpectraCell's panels are as follows: Vitamins A, B1, B2, B3, B6, B12, C, D, E, and K, as well as biotin, folate, pantothenate, calcium, magnesium, manganese, zinc, copper, asparagine, glutamine, serine, oleic acid, alpha-lipoic acid, coenzyme Q10, cysteine, glutathione, selenium, chromium, choline, inositol, and carnitine. SpectraCell also provides an assessment of "Total Antioxidant Function," an "Immune Response Score," and measures of fructose sensitivity and glucose-insulin metabolism (SpectraCell, 2021b).

Another test analyzing intracellular concentration is ExaTest by IntraCellular Diagnostics. From their laboratory website, this test uses "rapidly metabolizing sublingual epithelial cells under Analytical Scanning Electron Microscopy, (ASEM) an Energy Dispersive X-Ray Analysis, (EXA) to reflect fast tissue changes of vital mineral electrolytes." This test is primarily for aid with the management of heart disease and provides tissue evaluations of magnesium, sodium, calcium, phosphorus, potassium, and chloride. ExaTest proclaims its ability to follow a patient's metabolic status and assess electrolyte imbalance easily. First, the buccal, epithelial cells are swabbed from the patient. Then the sample is analyzed by the proprietary energy dispersive x-ray analysis and bombarded with X-Rays. Energy is released by wavelengths (unique to each element), and the element composition is analyzed and reported. ExaTest states that the serum or urine of some minerals do not correlate with intracellular levels and that these deficiencies are common in patients with various health issues, particularly heart disease. Buccal cells are used as they are easily accessible and have an easily analyzed structure for electrolytes (Exatest, 2014).

Vibrant America has also developed a test that gives both extracellular and intracellular information on approximately 40 vitamins, minerals, amino acids, fatty acids and antioxidants in the body (Vibrant, 2017). Vibrant America states that the benefits of intracellular testing include the identification of potential functional deficiencies in the cellular nutrient absorption process (which may increase the risk of certain diseases), and the identification of an individual's nutritional status in the previous four to six months (Vibrant, 2017).

Another possible method of analyzing nutrient deficiency is by measuring lymphocyte proliferation in response to micronutrient concentration. Cell Science Systems (CSS) released a cellular micronutrient assay (CMA) which measures the effect of micronutrients on lymphocyte proliferation when stimulated with a mitogen. According to their protocol, lymphocytes are primarily separated from the patient's whole blood and the patient's own serum is added back to the lymphocytes. The cells are stimulated with a mitogen and baseline lymphocyte proliferation rates (without the addition of micronutrients) are recorded. Next, micronutrients are added to the lymphocyte culture and proliferation rates are compared to the baseline rate. If the addition of micronutrients to the lymphocyte culture enhances lymphocyte proliferation, a nutrient insufficiency is reported. If the lymphocyte proliferation rate with the addition of micronutrients does not exceed the baseline rate, it likely indicates sufficient stores of that nutrient. The CMA measures vitamins, amino acids, minerals, and other nutrients such as carnitine, alpha-ketoglutarate, choline, glutathione, and inositol. By measuring intracellular levels of micronutrients, the test is intended to provide insight into the long-term nutritional status (6 months) versus the short term variability of serum nutrient levels, which is prone to daily fluctuations (Cell\_Science\_Systems, 2020). In 2020, the FDA approved the Baze blood testing kit for at-home use to assess nutrient status by analyzing 10 micronutrients. Through a small sample of whole blood, the testing device determines levels of choline, chromium, copper, magnesium, omega-3, selenium, vitamins B12, D, E, and zinc. The sample is mailed to a certified laboratory and analyzed using mass-spectrometry (Baze, 2020).

Genova Diagnostics released NutrEval FMV® a comprehensive blood and urine test that evaluates over 125 biomarkers and 40 antioxidants, vitamins, minerals, essential fatty acids, and amino acids in patients 2 years and older. These levels provide insight into digestive function, toxic exposure, mitochondrial function, and oxidative stress. According to their website, The NutrEval is not meant to be a substitute for other conventional nutritional panels (complete blood count, comprehensive

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metabolic panel), but rather a complement by providing additional information (Genova\_Diagnostics, 2021).

## ***Analytical Validity***

In a randomized observational analysis, the Cell Science Systems (CSS) cellular micronutrient assay (CMA) was used to examine nutritional status in 845 American individuals aged 13 years and older. Results were expressed as the stimulation index (SI), which is the percentage of lymphocyte stimulation in response to the mitogen. All subjects were divided into two groups based on their diet. The first group had a healthy diet, consisting of whole fresh foods including fruits, vegetables, nuts, while the poor diet group reported high consumption of sweets, fried, frozen, and starchy foods. CMA analysis indicated that the “mean values for micronutrient deficiency were significantly higher in the poor diet group as compared to the healthy diet group with p-values of 0.0017 and 0.0395, respectively.” According to the authors, “the adequate functioning of this defensive system is critically impacted by intracellular nutritional status, and its interaction with the host’ cells. Lacking adequate nutrition, the immune system is clearly deprived of the components needed to generate an effective immune response” (Steele et al., 2020).

## ***Clinical Utility and Validity***

While limited research has been completed regarding intracellular micronutrient lymphocyte analysis, Yamada et al. (2004) did complete a study with 41 type 2 diabetes patients and 50 healthy controls. No participants were taking vitamin supplements at the time of the study. Blood samples were taken from all participants during a fasting state; the researchers determined that the lymphocyte vitamin C level was significantly lower in the type 2 diabetes patients than in controls (Yamada et al., 2004). This study may support the above theory that lymphocytes can be used as an indicator of an individual’s nutrient state.

Houston (2010) published a small study stating that treating the intracellular micronutrient deficiencies in combination with optimal diet, exercise and other weight management resulted in reaching blood pressure goals for 62% of a hypertensive population (Houston, 2010). Another small study of 10 patients found that both genders showed overall improvement in their vitamin and mineral cellular storage balance after being tested with SpectraCell’s assessment (Frye, 2010). However, the authors of each of the aforementioned studies (Houston, Bucci, Frye, and Shive) are associated with SpectraCell Laboratories. SpectraCell has listed several studies on their website discussing serum versus intracellular deficiencies; from discussing the effect of the inflammatory response on serum micronutrient levels to Vitamin B12’s difficult serum profile to micronutrient deficiencies in special populations (SpectraCell, 2021a). However, none of these studies reported use SpectraCell’s actual method as of 2018, nor did the studies cover the healthy population for which the test is marketed. Most of these studies listed used other methods such as HPLC to measure micronutrient levels instead of the proprietary method provided by SpectraCell. Few other studies listed on SpectraCell’s website used lymphocytes as the analyte as well.

In an observational study, Coelho studied the association between serum and dietary antioxidant micronutrients and advanced liver fibrosis in non-alcoholic fatty liver disease (NAFLD). 72 NAFLD patients were evaluated for levels of retinol, alpha-tocopherol, ascorbic acid, beta-carotene, serum zinc, and selenium. “A high proportion of inadequate serum retinol (20.8%), vitamin C (27%), and selenium (73.6%) was observed in the patients with NAFLD, in addition to a significant inadequacy of vitamin A (98.3%) and vitamin E (100%) intake.” Those with advanced liver fibrosis had reduced levels of serum retinol. Overall, “NAFLD patients showed an important serum deficiency and insufficient dietary intake of the evaluated micronutrients (Coelho et al., 2020).”

## **Guidelines and Recommendations**

No studies evaluating the accuracy or clinical utility of intracellular micronutrient testing compared to standard testing for vitamin or mineral levels were identified. In addition, no controlled studies

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that evaluated changes to patient management or health impact of intracellular micronutrient testing were identified. Limited data are available on correlations between serum and intracellular micronutrient levels. Intracellular micronutrient analysis was not included in reviews on micronutrient analysis. (Elmadfa & Meyer, 2014; Raghavan et al., 2016)

No recommendations or practice guidelines recommending intracellular micronutrient testing were identified in a literature search.

## State and Federal Regulations, as applicable

### Food and Drug Administration (FDA)

Intracellular micronutrient testing is offered by companies SpectraCell, IntraCellular Diagnostics, and Cell Science Systems Corporation which have Clinical Laboratories Improvement Amendments (CLIA) accredited laboratories. SpectraCell's micronutrient panel test, the IntraCellular Diagnostics ExaTest, Genova Diagnostic's NutrEval FMV, and the Cell Science Systems Cellular Micronutrient Assay (CMA) have not been through the FDA approval process.

Many labs have developed specific tests that they must validate and perform in house. These laboratory-developed tests (LDTs) are regulated by the Centers for Medicare and Medicaid (CMS) as high-complexity tests under the Clinical Laboratory Improvement Amendments of 1988 (CLIA '88). LDTs are not approved or cleared by the U. S. Food and Drug Administration; however, FDA clearance or approval is not currently required for clinical use.

## Billing/Coding/Physician Documentation Information

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This policy may apply to the following codes. Inclusion of a code in this section does not guarantee that it will be reimbursed. For further information on reimbursement guidelines, please see Administrative Policies on the Blue Cross Blue Shield of North Carolina web site at [www.bcbsnc.com](http://www.bcbsnc.com). They are listed in the Category Search on the Medical Policy search page.

*Applicable service codes: 82128, 82136, 82180, 82310, 82379, 82495, 82525, 82607, 82652, 82725, 82746, 82978, 83735, 83785, 84207, 84252, 84255, 84425, 84446, 84590, 84591, 84597, 84630, 84999, 86353, 88348*

BCBSNC may request medical records for determination of medical necessity. When medical records are requested, letters of support and/or explanation are often useful, but are not sufficient documentation unless all specific information needed to make a medical necessity determination is included.

## Scientific Background and Reference Sources

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Baze. (2020). How Does the Baze Approach Differ from DNA and Dry Blood Spot Analyses? <https://magazine.baze.com/how-does-the-baze-approach-differ-from-dna-and-dry-blood-spot-analyses/>

CDC. (2015). Micronutrient Facts | IMMPaCt | CDC. @CDCgov. <https://www.cdc.gov/immimpact/micronutrients/>

Cell\_Science\_Systems. (2020). Understanding Your Cellular Nutrition Assays. <https://cellsciencesystems.com/pdfs/Understanding-Your-Alcat-Functional-Cellular-Assays.pdf>

Coelho, J. M., Cansanção, K., Perez, R. M., Leite, N. C., Padilha, P., Ramalho, A., & Peres, W. (2020). Association between serum and dietary antioxidant micronutrients and advanced liver fibrosis in non-alcoholic fatty liver disease: an observational study. *PeerJ*, 8, e9838. <https://doi.org/10.7717/peerj.9838>

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Elmadfa, I., & Meyer, A. L. (2014). Developing Suitable Methods of Nutritional Status Assessment: A Continuous Challenge. *Adv Nutr*, 5(5), 590S-598S. <https://doi.org/10.3945/an.113.005330>

Exatest. (2014). EXA Test Managing Heart Disease and Quality of Life full spectrum mineral analysis: Technical Process Retrieved 1/5/21 from <http://www.exatest.com/Technical%20Process.htm>

Fairfield, K. (2022, 11/02/2022). Vitamin supplementation in disease prevention. <https://www.uptodate.com/contents/vitamin-supplementation-in-disease-prevention>

Frieden, E. (1985). New perspectives on the essential trace elements. *Journal of Chemical Education*, 62(11), 917. <https://doi.org/10.1021/ed062p917>

Frye, D. L. (2010). Micronutrient Optimization Storage Trial Using Customized Vitamin & Mineral Replacement Therapy Most 2010. *Translational Biomedicine*, 1(3). <http://www.transbiomedicine.com/translational-biomedicine/micronutrient-optimization-storage-trial-using-customized-vitamin--mineral-replacement-therapy-most-2010.php?aid=2571>

Genova\_Diagnostics. (2021). NutrEval® FMV. <https://www.gdx.net/product/nutreval-fmv-nutritional-test-blood-urine>

Gidden, F., & Shenkin, A. (2000). Laboratory support of the clinical nutrition service. *Clin Chem Lab Med*, 38(8), 693-714. <https://doi.org/10.1515/ccilm.2000.100>

Houston, M. C. (2010). The role of cellular micronutrient analysis, nutraceuticals, vitamins, antioxidants and minerals in the prevention and treatment of hypertension and cardiovascular disease. *Ther Adv Cardiovasc Dis*, 4(3), 165-183. <https://doi.org/10.1177/1753944710368205>

Life, S. a. (2012). Micronutrients, Macro Impact. *Sight and Life*. <https://sightandlife.org/doi/10.52439/QBJI7343>

McCabe, D., Lisy, K., Lockwood, C., & Colbeck, M. (2017). The impact of essential fatty acid, B vitamins, vitamin C, magnesium and zinc supplementation on stress levels in women: a systematic review. *JBIS Database System Rev Implement Rep*, 15(2), 402-453. <https://doi.org/10.11124/jbisrir-2016-002965>

Pazirandeh, S., Burns, David, Griffin, Ian. (2022, 01/24/2022). Overview of dietary trace minerals. <https://www.uptodate.com/contents/overview-of-dietary-trace-minerals>

Pearce, E. N., Lazarus, J. H., Moreno-Reyes, R., & Zimmermann, M. B. (2016). Consequences of iodine deficiency and excess in pregnant women: an overview of current knowns and unknowns. *The American Journal of Clinical Nutrition*, 104(suppl\_3), 918S-923S. <https://doi.org/10.3945/ajcn.115.110429>

Preiser, J. C., van Zanten, A. R., Berger, M. M., Biolo, G., Casaer, M. P., Doig, G. S., Griffiths, R. D., Heyland, D. K., Hiesmayr, M., Iapichino, G., Laviano, A., Pichard, C., Singer, P., Van den Berghe, G., Wernerman, J., Wischmeyer, P., & Vincent, J. L. (2015). Metabolic and nutritional support of critically ill patients: consensus and controversies. *Crit Care*, 19, 35. <https://doi.org/10.1186/s13054-015-0737-8>

Raghavan, R., Ashour, F. S., & Bailey, R. (2016). A Review of Cutoffs for Nutritional Biomarkers. *Adv Nutr*, 7(1), 112-120. <https://doi.org/10.3945/an.115.009951>

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Shive, W., Pinkerton, F., Humphreys, J., Johnson, M. M., Hamilton, W. G., & Matthews, K. S. (1986). Development of a chemically defined serum- and protein-free medium for growth of human peripheral lymphocytes. *Proc Natl Acad Sci U S A*, 83(1), 9-13. <https://doi.org/10.1073/pnas.83.1.9>  
SpectraCell. (2021a). Clinical Research Library. Retrieved 1/5/21 from <https://spectracell.sitewrench.com/research-library>

SpectraCell. (2021b). LABORATORY REPORT.  
[https://assets.speakcdn.com/assets/2606/300\\_micronutrient\\_sample\\_report\\_8\\_19.pdf](https://assets.speakcdn.com/assets/2606/300_micronutrient_sample_report_8_19.pdf)

Steele, I., Allright, D., & Deutsch, R. (2020). A randomized observational analysis examining the correlation between patients' food sensitivities, micronutrient deficiencies, oxidative stress response and immune redox status. *Functional Foods in Health and Disease*, 10, 143-154.  
<https://doi.org/10.31989/ffhd.v10i3.695>

Vibrant. (2017). MICRONUTRIENTS Your guide to customized optimal nutrition.  
<https://www.vibrant-america.com/micronutrient/>

WHO. (1973). Trace elements in human nutrition. Report of a WHO expert committee. *World Health Organ Tech Rep Ser*, 532, 1-65. <https://www.ncbi.nlm.nih.gov/pubmed/4202138>

Yamada, H., Yamada, K., Waki, M., & Umegaki, K. (2004). Lymphocyte and plasma vitamin C levels in type 2 diabetic patients with and without diabetes complications. *Diabetes Care*, 27(10), 2491-2492. <https://doi.org/10.2337/diacare.27.10.2491>  
Specialty Matched Consultant Advisory Panel review 3/2020

Medical Director review 3/2020

Medical Director review 4/2023

## Policy Implementation/Update Information

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- 1/1/2019 BCBSNC will not provide coverage for intracellular micronutrient panel testing because it is considered investigational for all applications. BCBSNC does not provide coverage for investigational services or procedures. Medical Director review 1/1/2019. Policy noticed 1/1/2019 for effective date 4/1/2019. (jd)
- 5/14/19 Reviewed by Avalon 1<sup>st</sup> Quarter 2019 CAB. Minor revisions to Description section. Policy guidelines and references updated. Medical Director review 5/2019. (jd)
- 10/29/19 Wording in the Policy, When Covered, and/or Not Covered section(s) changed from Medical Necessity to Reimbursement language, where needed. (gm)
- 3/31/20 Specialty Matched Consultant Advisory Panel review 3/2020. Medical Director review 3/2020. (jd)
- 5/12/20 Reviewed by Avalon 1<sup>st</sup> Quarter 2020 CAB. Added the Related Policies section, to include Diagnosis of Idiopathic Environmental Intolerance AHS – G2056. Under the When Not Covered section, added “SpectraCell and ExaTest”. References updated. Medical Director review. (jd)
- 5/4/21 Reviewed by Avalon 1<sup>st</sup> Quarter 2021 CAB. Statement revised for clarity under the When Not Covered section by adding the following: “Cell Science Systems cell micronutrient assay”; no change to policy intent. Policy guidelines and references updated. Medical Director review 4/2021. (jd)

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- 5/17/22 Reviewed by Avalon 1<sup>st</sup> Quarter 2022 CAB. Policy guidelines updated and added “Table of Terminology”. References updated. No change to policy intent. Medical Director review. (jd)
- 5/16/23 Reviewed by Avalon 1st Quarter 2023 CAB. Policy Guidelines and References updated. Related Policies section removed. Not Covered section edited for clarity, no change to policy statement. Medical Director reviewed 4/2023. (tm)

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