Vital Link
The journal of the Canadian Association of Naturopathic Doctors

Feature Articles

- **In-Office Lab tests, Diagnostic Testing and Assessment Tools:** a Review
- **Using Functional Medicine Blood Testing in a Naturopathic Medical Practice**
- **Cardiac and Diabetic Biomarkers**
- **Food Allergies and Sensitivities:** Observing the Complete Picture
- **Medical Imaging:** Reasons, Benefits and Risks

Assessment and Diagnosis: A New Era

Volume 19, Issue 2
Summer 2012

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Vital Link

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Assessment and Diagnosis: A New Era

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J Sutton Communications • jsuttoncom.com

Mailing Address
Vital Link c/o Alex McKenna
CAND 20 Holly St., Ste. 200 • Toronto, Canada M4S 3B1
Phone 416.496.8633 • Fax 416.496.8634 • cand.ca

The *Vital Link* is the professional journal of the Canadian Association of Naturopathic Doctors (CAND). It is published primarily for CAND members and features detailed reviews of specific causal factors: philosophical and research-based papers, clinical practice articles and case reviews, as well as international updates on the profession. The *Vital Link* has an outreach to other health care professions and promotes qualified naturopathic doctors to corporations, insurance companies and the Canadian government.

Forthcoming Themes

Fall 2012 Occupations and Health
Spring 2013 Emerging Treatment Options

Submissions
When writing for the *Vital Link*, keep in mind its broad readership and outreach to other professions. Your contribution to the *Vital Link* will benefit the naturopathic profession as a whole and provide you with personal professional exposure. Previously unpublished material is preferred. Please contact the managing editor for submission guidelines.

Circulation
The *Vital Link* is published three times per year and is distributed to over 2000 qualified Canadian NDs and students of CNME-accredited naturopathic programs in Canada and the U.S. The *Vital Link* is also distributed to the CAND's corporate members and in our media kit. The journal is available in print and e-formats, by paid subscription.

Advertising
Professional vendors providing NHPD/Health Canada-compliant products or other services to NDs are encouraged to advertise in the *Vital Link*. The CAND's advertising partners enjoy unequalled exposure to qualified Canadian naturopathic doctors.

Naturopathic Notes

Dr. Iva Lloyd, BScH, RPE, ND

With much of the focus of health care being on the treatment side of the process, it is nice to take a break and look at advances in assessment tools. Naturopathic doctors are known for having strong assessment skills, especially as it relates to listening to a patient's story and spending the time to truly understand what symptoms a patient has and how those symptoms impact their life.

Nothing beats a thorough intake and physical exam. The skills of listening, palpation, sight and observation are central to a naturopathic assessment and proper diagnosis. The focus of this edition of the *Vital Link* is to review some of the assessment tools that are available and how they can assist in practice.

Proper assessment is the most critical aspect of health care. It provides information on the causal factors of disease, the depth of the pathology, the associated risk, the correct treatment approach, and the degree that a patient responds to treatment. Yet it is often the aspect that is given the least attention. A criticism of conventional medicine, and to a much lesser degree naturopathic medicine, is that treatments are prescribed based on symptoms and when a specific treatment fails to work, additional or different treatments are typically recommended without ever going back to assessment and understanding the true causes of diseases or the depth of the pathology. Even the majority of research and funding is spent on identifying new treatments, instead of figuring out the causes of disease, which would provide a much more targeted treatment approach.

The changes in provincial and insurance-based health care plans add to the problem. Instead of these plans expanding as new research identifies more effective blood tests to properly diagnose or monitor disease, or including heavy metal and environmental testing as part of a thorough assessment, most plan administrators are further restricting the tests that the plans cover and are encouraging shorter visits. The focus seems to be on making the assessment process as simple and cost-effective as possible, irrespective of the results. Even patients have been trained over the years and in drug-marketing campaigns to seek treatment without really understanding the root of their problems.

Naturopathic doctors are fortunate as we are not restricted in our ability to offer patients a thorough assessment. With our understanding of the causal factors of disease, the focus of most assessments are longer and more expansive and include not only the testing required to determine the depth of a pathology, but also the testing to determine the contributing lifestyle, external and environmental factors. Cost may be a factor for some patients, yet spending the money to properly assess and diagnose often saves money and hardship down the road. For those patients who are struggling with their condition or where "normal" treatments — whether conventional or naturopathic — just don't seem to be working it is often a lot more effective to spend the time and money on assessment before engaging in additional treatments.

In this edition of the *Vital Link*, Dr. Wales and I have provided an overview of some of the assessment tools available and the laboratory companies that commonly work with naturopathic doctors. The intention is not to encompass all related therapies, but to provide an overview some basic offerings and also a few specific items.

We also have a number of articles highlighting some of the latest research in blood testing. Dr. Dempster looks at the latest research in functional medicine testing, which questions the traditional use of blood as the sole marker for many vitamin and mineral deficiencies. He delves into the growing field of genomics, telomere and amino acid testing and its relevance to diagnosis and treatment strategy. My article provides an overview of the recommended cardiovascular and diabetic biomarkers and how they can be used to provide a greater sense of risk and treatment response. Dr. Trevorrow and Tracy Marsden explore the hot topic of food antibody testing, the theory behind it, what the different tests convey and how the testing can be used to achieve better patient outcomes.

Four students from CCNM, Rishi Metha, Jessica Sangiuliano, Emily Bennett and Aisling Lanigan, have tackled the task of reviewing the pros and cons of the most common imaging techniques. As the use of CT scans, MRIs, Ultrasound and PET scans continues to rise, it is important to step back and re-examine what these scans actually convey and whether the risks are worth the costs.

We hope you find this edition informative and worthwhile. Our fall issue will discuss the relationships between a patient's chosen profession, their overall vitality and susceptibility to illness. We welcome your comments and contributions.

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Four Corners: Updates on the Profession

Canadian Association of Naturopathic Doctors (CAND) *www.cand.ca*

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CAND membership now stands at 1484 NDs, representing approximately 80% of the Profession in Canada! Along with the Profession's rapid growth has come the changing of its marketing and communications needs. To meet the demand, the CAND has embarked on an extensive review and analysis of the marketing that has been done to date by and on behalf of the Profession. Our goal is to develop consistent and effective new messaging for the Association and our members, geared towards attracting new patients to choose naturopathic medicine as a solution for their health concerns.

An annual opportunity for NDs to attract new patients is one of our signature events, Naturopathic Medicine Week (NMW). This year, NMW took place from May 7-13 building on a strong foundation from years of collaboration with our provincial counterparts. Our doctors across Canada demonstrated a wonderful enthusiasm for hosting educational events throughout the week and Canadians responded with an eagerness to learn about the benefits of naturopathic medicine, individualized treatment and taking control of their own health. The CAND and its provincial representative team congratulate all participants for their teamwork in achieving such an effective awareness week highlighting naturopathic approaches to health.

Unity in the Profession is essential to ensuring an effective response to NDs' needs and the challenges that are impacting NDs across the country, especially in relation to lobbying for appropriate and effective regulation. In this regard we are pleased to report that the CAND and the OAND have signed a formal agreement to re-link memberships as of January 1, 2013. In accordance with CAND by-laws a Special Members' Meeting took place on June 2, 2012 affording members the opportunity to exercise their right to vote on the decision to re-link. We received a clear mandate with 60% of participants voting in favour of the re-link.

One of the terms of the Agreement was a return to one national insurance plan administered by the CAND and the restructuring of the CAND Insurance Committee to include representation from interested provinces. As we move towards January 1, 2013, members in Ontario will be kept advised of the process for transitioning their insurance from the OAND plan to the CAND national plan with Partners Indemnity (there will be no changes for those already enrolled with the CAND-Partners Indemnity plan).

We are in the final stages of selecting a firm to help our federal lobby efforts. We have accomplished a great deal in Ottawa but it is time to bring in the "big guns" to assist us in truly impacting health policy in this country and to ensure NDs have access to the substances they need in practice.

One of the important roles the CAND plays is representing and meeting with our naturopathic colleagues across Canada and in the United States. Spring saw the CAND attend the BCNA and CNPBC Annual General Meetings, host the Canadian Coordinating Council, and attend meetings of the Association of Accredited Naturopathic Medical Colleges and the Naturopathic Post Graduate Association.

Over the summer the CAND will be engaged in redrafting its by-laws to comply with the new Canada Not-for Profit Act. A Committee has been struck, an initial review and a first draft of the new by-laws completed. A draft of the by-laws will be brought before the membership for approval in due course.

As we move into 'summer mode' and anticipate the start of conference season with the AANP Annual Convention in Bellvue, Washington (see below for details), we wish all our members optimum hydration, sunny smiles and a chance for some reflection and rejuvenation.

American Association of Naturopathic Physicians (AANP) *www.naturopathic.org*

@aanp • facebook.com/theAANP

The American Association of Naturopathic Physicians (AANP) is a mission driven organization. Inspired by our members' desires, the Board of Directors defines its priorities from which a staff created work plan is designed. Our work is focused in three areas: expanding consumer awareness of naturopathic medicine, expanding state and federal recognition of naturopathic medicine and providing the tools our members need to be successful in their practices. For us, success in each of these arenas requires we aspire to the highest standards of naturopathic medicine.

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On May 5-7, 2012, the AANP held its Annual DC Federal Legislative Initiative (DC FLI). Participants were welcomed by Senator Tom Harkin (D-IA) via a video recording. Senator Harkin, a long time proponent of health care practitioner choice, called for inclusion of NDs in all Federal programs. Participants traveled to Capitol Hill to meet with their members and take this message. The lobby day was followed by a Capitol Hill reception where staff and members of Congress learned about naturopathic medicine while enjoying organic whole foods.

Please mark your calendars for the AANP's Annual Convention in Bellevue, WA, August 15-18, 2012. Registration is open and the line-up of speakers will knock your socks off!

Council on Naturopathic Medical Education (CNME) *www.cnme.org*

The Council on Naturopathic Medical Education (CNME) accredits naturopathic doctoral (ND) programs in Canada and the U.S., and graduation from a CNME-accredited or pre-accredited ND program is a requirement for taking the NPLEX exam and becoming licensed or regulated as a practitioner. Currently, the CNME accredits two ND programs in Canada and four in the U.S., and also pre-accredits one program in the U.S.

At its meeting in May 2012, the Council authorized the ND program of the Universidad del Turabo (UT) in the Commonwealth of Puerto Rico to begin work on a self-study report for candidacy status (i.e., pre-accreditation); if the Council accepts the report, UT will host a site team to visit the school to determine whether its ND program meets CNME's accreditation standards. The ND program is taught mainly in Spanish, though many of the course and reference materials are in English in order to prepare students to take the NPLEX exam. If the program succeeds in gaining CNME recognition, this will help to establish naturopathic medicine as a healthcare profession in Latin America.

The Council will be very busy with accreditation activities over the next 12 months, including the following:

- Review of the ND program offered by National University of Health Sciences (located in the Chicago, Illinois, area) for initial accreditation at the fall 2012 Council meeting;
- Reaccreditation site visits in 2013 to the ND programs offered by the following schools: Boucher Institute of Naturopathic Medicine; Canadian College of Naturopathic Medicine; Southwest College of Naturopathic Medicine & Health Sciences; University of Bridgeport College of Naturopathic Medicine; and Bastyr University.

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In-Office Lab Tests

Dr. Iva Lloyd, BScH, RPE, ND and **Dr. Patricia Wales,** ND

In-office functional assessment tests are an invaluable way to support a thorough naturopathic intake. These tests are cost effective, convenient and non-invasive. They provide objective measurements and provide the patient and practitioner with baseline measurements, confirmation of a suspected diagnosis, guidance on the staging of a condition and information on a patient's response to treatment.

The following table highlights the most common in-office lab tests (Note: the list of sources is not intended to be exhaustive).

ASSESSMENT TEST	CONSIDERATIONS
Standard Blood Tests Source: GDML, Life Labs, Rocky Mountain Analytical, through Calgary Laboratory Services	Even if you don't have the facilities to do blood draws in your clinic, labs such as Gamma Dynacare, or Life Labs and Rocky Mountain Analytical through CLS in Calgary can provide you with requisition forms for standard blood and urine tests. Your patients can then visit the labs to have their blood drawn and the lab will bill you directly.
Advanced Diagnostic Tests Source: See chart on pages 17 & 18	There are a number of advanced blood, urine, saliva and stool tests available.
ABO Blood Typing Source: Professional Health Products (PHP)	Simple finger-prick test for determining a patient's blood type. Blood types have been correlated with food sensitivities and susceptibilities to illness.
Cancer metabolites (breast & ovarian – urinary test) Source: www.metabolistics.com	Detection & monitoring of breast and ovarian cancer cell metabolites in urine. Useful for screening in high-risk patients and for monitoring of post-treatment patients.
Food Antibody Panels Source: GDML, Life Labs, plus see chart on page 17	For those clinics that are not set up for blood draws, consider the finger-prick assessment technique for IgG testing which can be done in any office. Serum testing is required for IgE and IgA testing.
Glucose finger prick Source: Diabetes Association, Drug Store	Provides an immediate measure of blood sugar. Contact your local Diabetes Association for diabetic supplies and for coupons for free glucometers for patients. Ensure that you use single-use disposable lancets, not the finger-prick device that comes with the kits.
Hair Mineral Analysis Source: See chart on page 18	For assessment of heavy metals and nutritional minerals. A sample of untreated hair can be taken in-office, by the patient at home or by their hairdresser/barber.
H. pylori test Source: BTNX.com, Gamma-Dynacare Medical Laboratories (GDML)	Finger prick test can be done in office to assess for the presence of H. pylori or for those patients that have a history of H. pylori a breath test can determine if the infection is now acute.
Indican Test Source: PHP	Evaluates digestive effectiveness and digestive health of the gut wall by measuring the oxidation of indoles - the product of intestinal decomposition of tryptophan in the gut. A positive test may indicate bacterial dysbiosis, IBD, Celiac disease, hypochlorhydria, liver disease, diminished peristalsis, Incomplete digestion, proliferation of putrefactive bacteria and a permeable or "leaky" gut wall that can result in immune system compromise, allergies, gas and bloating, and overall general fatigue.

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ASSESSMENT TEST	CONSIDERATIONS
Koenisburg Test Source: PHP	Tests for urinary chloride which reflects the level of aldosterone and its ability to conserve sodium (and potassium). This test is an indirect measurement of adrenal function and a person's ability to handle stress.
Mono Test Source: BTNX.com	The Mononucleosis Rapid Test Cassette is a chromatographic immunoassay for the detection of Infectious Mononucleosis heterophile antibodies in whole blood, serum or plasma via a finger-prick.
Oxidata Test Source: PHP	Urinary free radical test measuring aldehyde formed when fats are attacked by free-radicals and indicates the level of oxidative activity. Inadequate intake of antioxidants will be reflected in high levels of free-radical activity and vice versa. Lack of antioxidant leads to tissue damage such as inflammation, allergies, headaches, cardiovascular damage and fatigue.
pH of Saliva and Urine Source: pH strips and lemon juice	pH paper can be used to test saliva and urine pH levels. Urine will normally be slightly more acid than saliva as excess acidity is excreted through the urine. Consistently low pH of both urine and saliva indicates acidity and correlates with loss of mineral reserves, pro-inflammatory states, tissue/nervous system irritability and a probable high intake of sugars. Salivary pH can be used to do an oral challenge with concentrated lemon juice to assess alkaline mineral stores.
Pregnancy Test Source: BTNX.com, plus most medical supply companies	Not only to assess for pregnancy, but may also used as a cancer screening tool for some hormone based cancers like prostate cancer and breast cancer.
Respiratory Function Test Source: PHP, most medical supply companies	Peak Flow is a measurement of "peak expiratory flow rate" – the speed at which you can blow air out of your lungs after taking a big breathe. This tool is useful to monitor asthma or chronic lung function. More sophisticated devices are also available for more expansive and accurate assessment.
Saliva Testing Source: See chart on page 18	Saliva testing is beneficial for assessing hormone levels (DHEA, cortisol, estrogen, testosterone and progesterone, SIgA and anti-gliadin antibodies. As this testing is typically done at home, it can easily be accommodated by any clinic.
Strep Test Source: BTNX.com	The Strep-A Rapid Test is used to qualitatively detect Strep A antigen from throat swab specimens to aid in the diagnosis of Group A Streptococcal infection.
Sulkowich Test Source: PHP	Measures the amount of calcium excreted in the urine which provides insight on how well the body is able to absorb and utilize calcium, if calcium is being lost and whether or not calcium supplementation is required or effective.
Urinalysis Source: most medical supply companies	A must for assessment of urinary tract infections, kidney function and diabetes monitoring. Provides information on urine acidity, specific gravity (which reflects hydration levels), presence of glucose, ketones, blood, protein, bilirubin, urobilinogen, nitrates and leukocytes. Some suppliers (such as BTNX) provide practitioners with a Ree Machine that accurately reads the dip stick and provides a print out for more accurate record keeping.
Urine Testing Source: See chart on pages 17 & 18	For assessment of heavy metals, porphyrins, estrogen ratio, nutritional levels and other metabolic functions.
Vitamin C (urinary test) Source: PHP, may also be part of the Chemstrip Urinalysis	Measures the level of vitamin C that is excreted. High scores indicate depletion and determine possible need for increased intake.
Zinc Tally Source: PHP	Provides a look at zinc levels in the body by noting the patient's taste of a measured volume of zinc solution at a specific concentration. Absence of taste indicates low zinc in taste buds and reflects low zinc levels in the body.

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References: 1. Dhawan, K., Dhawan, S., Sharma, A. (1994) Passiflora: a review update. J Ethnopharmacol 94:1-23; 2. Grundmann, O., Wähling, C., Staiger, C., Butterweck, V. (2009) Anxiolytic effects of a passion flower (Passiflora incarnata L.) extract in the elevated plus maze in mice. Pharmazie 64: 63-64; 3. Grundmann, O., Wang, J., McGregor, G, Butterweck, V. (2008) Anxiolytic activity of a phytochemically characterized Passiflora incarnata extract is mediated via the GABAergic system. Planta Med 74: 1769-1773; 4. Dhawan, K., Kumar, S., Sharma, A. (2001) Anti-anxiety studies on extracts of Passiflora incarnata Linnaeus. J Ethnopharmacol 78: 165-170; 5. Akhondzadeh, A., Naghavi, H., Vazirian, M., Shayeganpour, A., Rashidi, H., Khani, M. (2001) Passionflower in the treatment of generalized anxiety: a pilot double-blind randomized controlled trial with oxazepam. J Clin Pharm Ther 26: 363-367

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Common Advanced Diagnostic Testing

	TEST NAME	ALCAT	CanAlt	Diagnos-Techs	Doctor's Data	Genova Diagnostics	RMA	US BioTek
Blood	Amino Acids				✓	✓		
	Antibiotic / anti-inflammatory intolerance	✓						
	Candida Antibody and Antigen Panel					✓	✓	✓
	Cardiovascular Risk Profile				✓	✓		
	Celiac Antibody Panel					✓	✓	✓
	Chronic Viral Disease					✓		
	Creatinine Clearance (with urine sample)				✓		✓	
	Environmental Chemicals	✓				✓	✓	✓
	Fatty Acid				✓	✓	✓	
	Food additives and colourings	✓						
	Food Antibody Panels	✓				✓	✓	✓
	Functional food Antibody Panels	✓					✓	
	Glutathione				✓	✓		
	Methylation Profile				✓	✓		
	Aeroallergens including Molds	✓				✓	✓	✓
	Omega 3 Score						✓	
	Oxidized LDL				✓			
	Oxidative Stress					✓		
	Spices & Herbs Antibody Panels	✓					✓	✓
	Whole Blood Elements				✓	✓		
Urine	Adrenal Steroids					✓		
	Amino Acids				✓	✓		
	Bone Health			✓		✓		
	Essential Elements		✓		✓		✓	
	Environmental Pollutants Profile				✓		✓	✓
	Estrogens						✓	
	Fluorides				✓			
	Halides				✓			
	Hepatic Detox Profile				✓	✓		
	Steroid Hormone Profile					✓		✓

continued page 18

	TEST NAME	ALCAT	CanAlt	Diagnos-Techs	Doctor's Data	Genova Diagnostics	RMA	US BioTek
Urine	Intestinal Permeability				✓			
	Iodine				✓			
	Metabolic Profile (Organic Acids)					✓		✓
	Oxidative Damage				✓	✓		
	Porphyrins				✓			
	Thyroid						✓	
	Toxic Metals		✓		✓		✓	
Saliva	Adrenal Stress Tests			✓		✓	✓	
	Bone Health			✓		✓		
	Female Hormones			✓		✓	✓	
	Food Antibodies			✓		✓		
	Gastrointestinal Health			✓		✓		
	Male Hormone			✓		✓	✓	
	Menopausal Hormones			✓		✓	✓	
	Thyroid Hormones					✓		
Breath	Lactose Intolerance					✓		
Hair	Hair Nutritional Elements		✓		✓		✓	
	Heavy Metals		✓		✓		✓	
	Hair Cortisol Test		✓					
Stool	Bacterial Cultures / Overgrowth			✓	✓	✓		
	C. difficile			✓	✓	✓		
	Digestive Function				✓	✓		
	Elastase				✓			
	Fecal Metals				✓			
	Gastrointestinal Health			✓	✓	✓		
	H. pylori				✓	✓		
	Intestinal permeability				✓	✓		
	Lactoferrin				✓	✓		
	Lysozyme			✓	✓			
	Parasitology			✓	✓	✓		
	Secretory IgA			✓	✓			
	Stool Analysis				✓	✓		
	Yeast culture			✓	✓	✓		

Laboratory Resource:

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DiagnosTechs www.diagnostechs.com
Doctor's Data www.doctorsdata.com
Genova Diagnostics www.gdx.net
Metametrix Laboratory www.metametrix.com
Rocky Mountain Analytical www.rmalab.com
SpectraCell Laboratories www.spectracell.com
US BioTek www.usbiotek.com

Treatment Room Assessment Tools

A thorough intake coupled with a thorough physical assessment that utilizes the patient's awareness of touch, vision, hearing and smell can enhance patient outcome by providing an accurate diagnosis. The following are some "must have" treatment room assessment tools.

ASSESSMENT TOOL	CONSIDERATIONS
Otoscope or penlight	Assesses the pupilary response to light: normal response is the ability to maintain papillary constriction for at least 10 seconds. Shorter times or a pattern of opening and closing indicate compromised adrenal function.
Opthalamoscope	Consider the PanOptic™ Opthalmoscope by Welch Allyn, which provides a panoramic view of the fundus five times larger than standard opthalmoscopes – this makes conditions such as hypertension, diabetic retinopathy and papilledema much easier to identify.
Sphygmomanometer	Remember the most accurate blood pressure readings are achieved before any morning doses of blood pressure medication, at least 1 hour after exercising, smoking or consuming coffee and when a patient has relaxed for at least 5 minutes. Assessing both right and left arms provides additional information about peripheral artery disease and the risk of aortic aneursym. Orthostatic blood pressure refers to the supine assessment of blood pressure which is then repeated with the patient standing. A drop in blood pressure on standing indicates inability to maintain the slight increase in blood vessel constriction necessary to keep blood from pooling in lower body. The resulting inadequate blood flow to head can result in light headedness or dizziness upon standing. This BP drop on standing reflects inadequate adrenal output and imbalance of adrenalin and cortisol. It can also indicate low iron levels and lead to further blood testing for iron.
Scales	Consider having two scales side-by-side to assess for weight distribution right-to-left. This is helpful when assessing posture or gait imbalances and when tracking the effectiveness of body work on postural and musculoskeletal issues.
Oximeter	Oximeters are an objective way to assess pulse rate and oxygen saturation especially when the SpO2 is greater than 75%. Invest in a good one![1]
Tuning forks	Tuning forks are effective in screening for a number of fractures.[2] The tuning fork tests of Rinne, Weber, and absolute bone conduction, when combined and interpreted, can be reliable initial diagnostic tools. They can be used to decide whether referral to a specialist or further audiometric testing is required.[3]
Reflex hammer	Ankle and patellar reflexes are more reliable than the triceps reflex.[4]
Measuring tape	Measuring waist circumference, BMI and waist-hip-ratio is valuable in the assessment of obesity and cardiovascular disease (CVD) risk factors[5] and in the monitoring of weight-loss programs.
Thermometer	Basal Body Temperature – axillary or mouth temperatures in office or at home immediately upon awakening before arising over many days. Repeatedly low temperatures are strongly correlated with hypothyroid activity. The pattern of temperatures over the female monthly cycle can reflect hormonal fluctuations, detect ovulation patterns and provide information on estrogen-progesterone-thyroid interactions. BBT may be an inaccurate predictor of the precise day of the LH surge, yet it does provide a reasonably accurate guide to the 2-3 day period on either side of the LH surge.[6]
Mirror	A mirror is a valuable tool in increasing a patient's awareness of things such as notable tongue diagnosis findings, pointing out key skin lesions that need ongoing observation.
Camera	An essential tool in tracking the changes in skin lesions and the response to treatment, and postural evaluation/correction.

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Additional Assessment Tools

ASSESSMENT TOOL	CONSIDERATIONS
Gait assessment	A computerized assessment of gait and weight distribution on the feet.
Hand grip strength	When working with MVA patients or patients that have pathologies that can affect muscle strength such as ALS or MS, the hand-grip strength is an objective way of assessing changes in muscle strength.
Goniometers	Useful to assess and track changes in range of motion of joints.
Iridology camera	For those trained in iridology assessment an iridology camera maybe a worthwhile investment, yet an otoscope is all that is needed to detect prominent iridology patterns.
Postural analysis chart	Provides a grid for a more accurate assessment of postural misalignment concerns.
CapnoTrainer® www.betterphysiology.com	The CapnoTrainer is a computer-based program that is used to monitor end tidal partial pressure carbon dioxide. It provides an effective way to evaluate, observe and learn breathing behaviour. It also provides a means of assisting individuals how to properly breathe through biofeedback.
BioClip® www.bio-clip.com	Cardiovascular monitoring at your finger tip. This computer-based program assesses arterial stiffness, vascular tone, vascular age, heart rate and oxygenation of blood using a device similar to an oximeter.
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Using Functional Medicine Blood Testing in a Naturopathic Medical Practice

Dr. John Dempster, ND, FAAFM

It is a very exciting time in health care for naturopathic doctors (NDs). In the last decade, medicine has been evolving at a feverish pace and never before has there been such a demand and public need for what naturopathic medicine can offer in the health care arena. As chronic illness continues to climb at record rates, the demands on the health care system are staggering and resulting in billions of dollars spent annually to treat chronic, preventable diseases such as cancer, heart disease, diabetes and auto-immune illness.

Sadly, primary treatment for many illnesses and diseases is only initiated once blatant symptomalogy occurs, missing the opportunity to treat the disease at its onset. As NDs, our objective is to treat the individual while identifying the root cause of disease and we are fortunate to live in an era where leaders in science & technology are putting forth cutting edge research, medical diagnostics and imaging. Biomarker diagnostics are powerful tools that allow the healthcare provider to tailor a treatment plan for each individual rather than following a 'one-size fits all', algorithmic-approach. Fortunately, as NDs we prioritize and value patient-focused, customized medicine while being granted the luxury to have a sufficient amount of time to spend in consultation with each patient. This privilege grants us the opportunity to actively listen and truly engage with our patients, which is vital in understanding and respecting their specific health goals.

While naturopathic medicine is deeply rooted in therapies that have withstood the test of time for decades, if not centuries – it is not to say that our medicine is out-dated by any means. Evolving science in the field of functional medicine, nutrigenomics, and epigenetics has brought forth new diagnostic 'tools' that further assist primary caregivers in helping to heal their patients using the principles and practice of naturopathic medicine. The purpose of this article to is provide a few examples of how innovations in functional blood laboratory testing can assist in improving the quality of information, treatment, and care we provide our patients with on a daily basis.

Micronutrient Testing

An overwhelming amount of scientific evidence confirms that various nutrient deficiencies are correlated with disease processes and the overall condition of one's health. Vitamin, mineral and antioxidant deficiencies have been shown to suppress immune function and contribute to chronic degenerative processes such as arthritis, cancer, Alzheimer's, cardiovascular disease and diabetes. This body of research has been reaffirmed by many leading publications, including the *Journal of the American Medical Association*,[1] and researchers continue to investigate the most effective and applicable way to measure deficiencies in humans. Traditionally, standard serum blood draws have been viewed as the gold standard for nutrient assessment. However, current medical literature demonstrates that standard serum blood draws may be somewhat limiting and not reflective of true cellular deficiencies. One example is a study performed on mothers with recurrent pregnancy loss (miscarriage, SAB) and/or birth defects. This study demonstrated adequate levels of maternal folate in serum, while intracellular RBC testing demonstrated consistent folate deficiencies throughout the study group.[2] Another study published in the American Journal of Clinical Nutrition, assessed the use of pyridoxine testing in patients with critical illness in order to understand the role of vitamin B6 with regards to inflammatory responses. This study found consistent deficiencies upon intracellular testing in patients who otherwise tested within normal limits with standard serum testing.[3] A third example cites a study testing for magnesium deficiencies and insulin resistance in those with metabolic syndrome. This study also provided evidence that demonstrates the superiority of intracellular vs. serum testing levels of nutrients.[4] It found that intracellular magnesium depletions in mononuclear cells is more common in people with metabolic syndrome. Static serum levels are not always representative indicators for assessing cell metabolism and utilization. Plasma concentrations of several trace elements and vitamins decrease because of the systemic inflammatory response and thus, low values do not necessarily indicate deficiency.[5] While the purpose of this article is not to promote any particular laboratories, there are select few that set themselves apart in the field of intracellular micronutrient testing. Micronutrient testing offers a unique means to empirically assess the intracellular requirements of micronutrients and their role in an individual's overall health and wellness. Cumulative research has provided evidence that levels of micronutrients such as; magnesium, selenium, vitamins B6, B5 and B12, vitamins C, E and A and zinc are more accurately measured when testing intracellular levels verses serum.

Single Nucleotide Polymorphism (SNP) testing

A fascinating, highly researched and growing area of medicine that has emerged in recent years is the field of genomics. Our DNA — the building blocks of life — once thought to be a static set of genetic material is now understood to be more influenced by our emotions, lifestyle, diet and environment than previously suggested. Intriguing work in the field of epigenetics has postulated that genes can act similarly to 'light switches', that can be switched on or off depending on nutritional, environmental, and emotional factors. Single nucleotide polymorphisms, or SNPs, are DNA sequence variations that occur when a single nucleotide (A,T,C,or G) in the genome sequence is altered. (i.e.: A**A**GGCTAA to A**T**GGCTAA.) Although more than 99% of human DNA sequences are the same, variations in DNA sequence can have a major impact on how humans respond to disease, and to environmental factors such as bacteria, viruses, toxins, drugs and other therapies.[6] This makes the understanding of SNPs not only highly beneficial in providing a preventative and treatment plan to our patients, but also provides valuable information for biomedical research - including the development of nutraceutical and pharmaceutical products, as well as medical diagnostics. Scientists believe SNP maps will help them identify the multiple genes associated with complex ailments such as cancer, diabetes, vascular disease, and some forms of mental illness. These associations are difficult to establish with conventional gene-hunting methods because a single altered gene may make only a small contribution to the disease. Many SNPs have no effect on cell function, but scientists believe others could predispose individuals to disease or influence their response to a specific treatment plan (i.e., nutritional or pharmacological).

In addition to pharmacogenomic, diagnostic and biomedical research implications, SNP maps are helping to identify thousands of additional markers in the genome, thus simplifying navigation of the much larger genome map generated by HGP (human genome project) researchers. SNPs are also evolutionarily stable — not changing much from generation to generation — making them easier to follow in population studies. Noted functional medicine expert, Dr. Jeff Bland, PhD, has stated that genotypic SNP testing "has a tremendous opportunity to create greater patient awareness and effectively tailored therapy." SNP testing is a powerful functional medicine blood test that provides a 'snapshot' of an individual's overall risk of specific illness (depending on SNPs tested) by looking at variants or single nucleotide polymorphisms. This is clinically applicable for the ND as this type of testing can help to illuminate part of a patient's medical destiny, therefore customizing a true prevention plan. Genova Diagnostics provides excellent panels in cardiology, immunity, neurology, endocrinology and detoxification pathways.

Telomere Testing

In 2009, the Nobel Prize in Physiology and Medicine was awarded to two brilliant scientists, Drs Elizabeth Blackburn and Jack Szostak, whose research linked telomere length to its role in various degenerative processes. Although their initial research was performed on plasmid vectors, the data is currently being extrapolated in human models. As a result of this groundbreaking research, telomere biology has recently emerged as an important player as it pertains to our understanding of aging and various disease processes.

Telomeres are sections of DNA at the end of each chromosome that serve as protective buffers keeping the ends of the chromosomes from becoming attached to each other or rearranging. In this way, telomeres prevent chromosomal fraying, much like the plastic coating at the end of shoelaces keeping the shoelace intact and prevent the loss of necessary information at the end of each chromosome.

Every time a cell replicates, its telomere become shorter, eventually causing cell death once the telomere attrition has reached a critical length. It is estimated that human telomeres lose about 100 base pairs from their telomeric DNA during each mitosis and disappear completely after approximately 125 mitotic divisions.[7]

Cells maintain the length of their telomeres with an enzyme called telomerase, that add genetic material to the ends of the DNA strand, thus lengthening the number of times it can replicate, and ultimately prolonging the life of the cell.[8] Telomerase is not active in most cells, but is active in stem cells, germ cells, hair follicles and most cancer cells.

Shorter telomeres imply a shorter life span for the cell and have been associated with metabolic abnormalities, obesity and several degenerative diseases including cancer, dementia and cardiovascular disease. In vitro studies have shown that telomeres are highly susceptible to oxidative stress, which will shorten telomere length and enhance cellular aging. Studies have found shorter telomeres to be associated with an increased incidence of developing various cancers, especially bladder, esophageal, gastric, head and neck, ovarian and renal.[9]

Risk factors associated with shortened telomeres have been well documented and minimizing associated risk factors that are linked to shortened telomere activity is recommended. Some preventative measures include:

- Reducing oxidative stress
- Correcting micronutrient deficiencies, in particular, vitamin C, D and E
- Changing sedentary lifestyle by increasing physical activity and avoiding weight gain/obesity
- Correcting insulin resistance

While more research is needed to further understand the role of telomeres and how we can apply this information to help optimize our patients' health and wellness, telomere testing has become a helpful biomarker in understanding in degenerative processes. As with all testing, proper interpretation of functional medicine data is essential to communicate and relay relevant information in an effective and judicious manner. Telomere testing is applicable clinically to NDs as this test provides a biomarker that can begin to quantify how preventative programs based on nutritional, environmental and lifestyle strategies improve the health and outcome of our patients.

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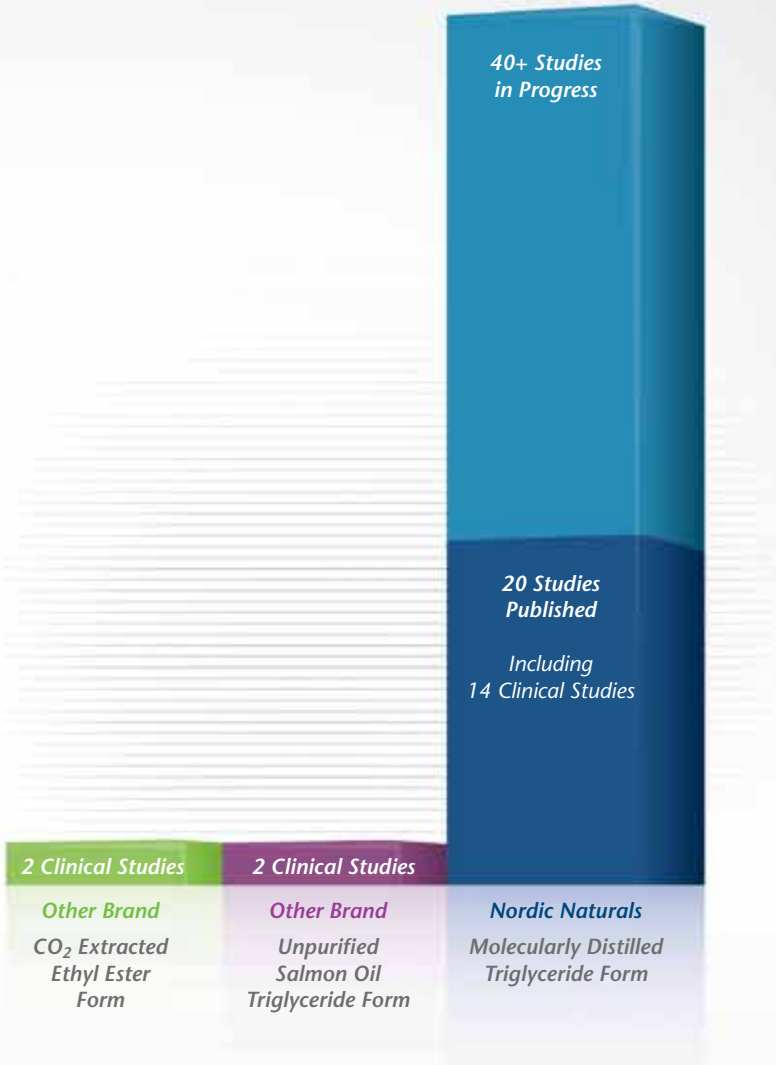

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Amino acids, known as the "building blocks" of proteins, are found in every tissue of the body. They have a more diverse function than any other nutrient group and play a major role in nearly every chemical process that affects both physical and mental function. Gastrointestinal function, cellular energy production, detoxification, healthy vascular function, and muscle catabolism are dependent on their continuous supply of amino acids. Amino acids play a critical role in the formation of ligaments, tendons and bones as well as the formation of antibodies and the regulation of enzymes and blood transport proteins. As they are powerful cofactors necessary for neurotransmitter production, an accurate understanding of amino acids levels is necessary when treating any form of mental illness, specifically depression.[10]

Twenty different amino acids are used to synthesize proteins. The human body has all of the amino acids necessary to manufacture proteins, with the exception of ten amino acids, referred to as the "essential amino acids". These ten must be included in the diet or supplemented in order to be in adequate supply and require optimal digestion and absorption in order to attain sufficient levels. Failure to obtain enough of even one of these essential amino acids has serious health implications and can result in the degradation of muscle and other protein structures by the body in order to obtain the amino acid that is needed. Thus, a daily intake of adequate dietary protein is necessary to present tissue protein breakdown to supply the continuous amino acid needs.

The utilization of amino acids is highly tissue and time dependent. Plasma from blood drawn at any given moment will reflect the state of dynamic flux of amino acids leaving sites such as skeletal muscle and flowing into sites of utilization in the liver, brain and other tissues.[11] This gives the clinician an idea of the net effect of these two opposing forces controlling the levels of amino acids. Either a fasting plasma or whole blood amino acid profile will identify low amino acids and may be used to evaluate whether a patient is in need of an essential or conditionally essential amino acids. Fasting blood plasma avoids recent dietary influences and can provide a high level of reliability for showing changes in individual amino acid demands due to chronic stressors. Those who should be considered for amino acid testing are any patients with chronic illness (e.g., Multiple Sclerosis), malabsorption (e.g., celiac, IBD), detoxification disorders and those with cardiovascular complications (e.g., arrhythmia, hypertension and CVD).

Closing remarks

While standard blood testing is a critical part of understanding specific biochemical parameters, newly emerging functional medicine blood tests are bringing forth exciting information that can be applied to each individual patient. These tests help facilitate the development of a more refined, customized approach to aiding each patient along their health journey. It is my opinion that in order to provide our patients with the full spectrum of naturopathic medicine, we as NDs need to fully embrace the tools of our ancestors while also forging ahead and accessing the power and potential that modern science and technology brings to the table.

About the Author

Dr. John Dempster, ND is the medical director/founder of The Dempster Clinic – Center for Integrated Medicine, located in Yorkville, Toronto. He treats a variety of patients ranging from high performance individuals to those suffering from chronic illness. As an avid seeker in integrative and evidence-based medicine, he has furthered his studies by completing an advanced fellowship in functional, regenerative, and anti-aging medicine (FAAFM). In addition to his busy practice, he writes regularly for a number of publications and speaks to corporations on a variety of health & wellness topics. In addition, he is also featured frequently on national television and radio, and in newspapers and magazines. You can follow Dr. D on twitter @drjohndempster
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Cardiac and Diabetic Biomarkers

Dr. Iva Lloyd, BScH, RPE, ND

It has been said that you will only find what you look for and in the case of medicine, blood tests are no exception. Many of the intricacies of cardiovascular and blood sugar regulation are overlooked because the "standard" conventional testing performed as part of an annual check-up is often inadequate. The numerous individual biomarkers available for testing each convey a piece of the puzzle and when used appropriately can dramatically assist in accurately diagnosing a patient's risk of illness and response to treatment.

Whether the omission of these easily accessible tests is a cost saving measure on the part of the current provincial health care (or insurance-based) systems or rather due to practitioner apathy, the fundamental result is that patients are not receiving the standard of care that reflects the latest research.

As naturopathic doctors we have the ability to provide patients with a better overall assessment and care. There is no doubt that identifying and addressing the dietary, lifestyle, emotional and environmental factors related to cardiovascular disease and diabetes is the most important part of the assessment process. Both cardiovascular disease and diabetes are considered to be the product of modifiable health risks that are associated with lifestyle choices and are known for their lack of overt symptoms. Assessing a patient's individual risk, determining the aggressiveness of a treatment plan and monitoring the impact of any treatment is best done by measuring specific biomarkers for each condition.

Cardiac Biomarkers

While blood pressure is recognized as an important risk factor for stroke and ischemic heart disease, the measurement of blood pressure is a poor screening test for overall cardiovascular risk health.[1] The non-laboratory tests, such as an electrocardiogram, coronary angiogram, carotid doppler, echocardiogram, stress test and chest X-ray are valuable in assessing the size, shape and function of the heart. They can be used to detect changes in heart rhythm and to identify and evaluate damaged tissues and arterial blockage. Although these imaging tests can provide an immense amount of valuable information, blood tests are a much more cost-effective and accessible tool for screening and monitoring.

Even though LDL and blood pressure have been shown to have limited correlation to the incidence of cardiovascular events, they are often used as the only parameters for assessing risk. Most of the patients whom I work with have been prescribed statins and anti-hypertensive medications on elevation of one or both of these parameters alone. The cardiac biomarkers recommended by up-to-date research to diagnose, evaluate and monitor individuals suspected of having heart disease include Troponin I or T, Creatine Kinase – MB, Myoglobin, BNP (or proBNP) and hs-CRP. When assessing for atherosclerosis measuring LDL along with apolipoprotein B or homocysteine is helpful. Other more general tests that are helpful when assessing cardiac risk include blood gases, CMP, BMP, electrolytes and CBC. Some of the advantages of these tests include:

- **Troponins** are a family of proteins found in skeletal and heart muscle fibers. Together, these three proteins regulate muscular contraction. There are three different types: troponin C, troponin T, and troponin I. Troponin I and T are are specific to heart muscle and when there is damage to the heart muscle cells, these proteins are released into circulation. After an angina attack or myocardial infarction, levels of troponin I and T in the circulation become elevated within 3 to 4 hours and remain elevated for 10 to 14 days. This test is the most specific of all the cardiac biomarkers for ruling out a suspected heart attack. It is also valuable in detecting and evaluating mild to severe heart damage.
- **Creatine Kinase-MB**. Elevated levels of creatine kinase MB (CK-MB) and troponin I (Tn-I) have been regarded as biochemical markers of myocyte necrosis and are raised in those with congestive heart failure.[2] Creatine Kinase-MB is one of three separate isoenzymes of creatine kinase found in heart and skeletal muscle. CK-MB rises in response to cardiac muscle damage and in the case of angina or heart attack the level of CK-MB rises within 3 to 4 hours, peaks within 18 to 24 hours and then returns to normal after 72 hours. Chronic heart diseases, electric cardioversion for heart rhythm disturbances, coronary catheterization, and exercise usually do not produce increases of CK-MB, although the markers for angina/MI such as abnormal aspartate aminotransferase (AST), creatine kinase (CK), lactate dehydrogenase (LDH),

and lactate dehydrogenase isoenzyme 1 activities are seen to be elevated in some individuals. Because CK-MB is also present in the skeletal muscle in low activities, substantial injury to skeletal muscle can increase CK-MB activities in the blood to abnormal values. Clinically, since the symptoms of a pulmonary embolism can often mimic and be mistaken for a myocardial infarction, these biomarkers are useful in detecting and diagnosing the cause of symptoms. In patients with an accurately known time of symptom onset and serial enzyme analysis conducted every 12 hours during the first 48 hours, acute myocardial infarction can be distinguished from pulmonary embolism by determinations of creatine kinase, CK-MB, aspartate aminotransferase, and lactate dehydrogenase isoenzyme 1 in serum.[3]

- **Myoglobin** is a small, oxygen-binding protein found in heart and skeletal muscles and its function is to trap oxygen, allowing the cells to produce the energy required for muscular contraction. When heart or skeletal muscle is injured, myoglobin is released into the blood and excreted via the kidney. Levels of myoglobin start to rise within 2 to 3 hours after heart muscle injury, reach their peak within 8 to 12 hours and then return to normal typically within a day. Since large quantities of myoglobin are nephrotoxic, the measurement of myoglobin in the urine is valuable when there is an underlying kidney disease and helps detect whether or not myoglobin are damaging the kidneys.

- **ProBNP**, also known as brain natriuretic peptide is a marker for heart failure. BNP is produced primarily by the left ventricle and it is associated with blood volume, pressure and with left ventricular workload. When the left ventricle is stretched, the blood concentration of BNP increases indicating that the heart is having trouble meeting the body's demands. Including proBNP as part of a cardiovascular workup markedly improves heart failure risk prediction. For any patients who have or are suspected to have CHF, this biomarker is a valuable addition,[4] especially for older adults that have an intermediate-risk.[5]

- **hsCRP**. CRP is made by the liver and is an acute phase reactant used to measure inflammation and infection. The use of high-sensitivity C-reactive protein (hsCRP) to assess risk stratification for cardiovascular disease is a valuable asset, especially due to the association between inflammation and atherosclerosis.[6] Measuring hsCRP is primarily valuable in healthy individuals as it is a better predictor of the future risk of heart disease, stroke and peripheral artery disease than conventional cholesterol measurements alone. Recent illness, tissue injury, infection or inflammation, HRT, diabetes, and colon cancer will raise CRP and give a falsely elevated risk.[6]

- **Lipoproteins**. Lipoprotein A [Lp(a)] is an LDL molecule that does not respond to typical strategies to lower LDL such as diet, exercise or most lipid-lowering drugs. Lipoprotein-B or lipoprotein-associated phospholipase A2 is an enzyme produced by macrophages - immune cells that eat and destroy foreign proteins, old cells, debris and microorganisms. Lipoprotein-B plays a role in the inflammation of blood vessels and is thought to help promote atherosclerosis. It is an independent risk factor for cardiovascular events and can be helpful in providing a more detailed look at the risk of atherosclerosis in the presence of a high LDL reading.

- **Homocysteine** (HCY) is a sulfur-containing amino acid that is a product of methionine metabolism. Vitamins B6, B12 and folate are necessary to metabolize homocysteine. Elevated HCY levels can be caused by a number of factors, including folate and B-vitamin deficiencies, pre-existing atherosclerotic disease, diabetes and various drugs. Elevated HCY levels are associated with increased risk of cardiovascular disease[7] especially in those patients with renal disease[8] as well as an increased risk of Alzheimer's disease. There is debate in the medical literature as to whether treating the folate and B-vitamin deficiencies associated with increased homocysteine levels results in decreased cardiovascular risk.[7, 9] The testing of homocysteine is sometimes done to determine if a person has vitamin B12 or folate deficiency as levels of homocysteine appear to rise before abnormal serum B12 and folate levels are measureable.

Diabetes Monitoring

Fasting blood glucose (FBG) levels have been shown to be an independent risk factor for the development of NIDDM.[10] The American Diabetes Association recommends the use of FBG as the primary guide to diagnosing diabetes. In the late 1990s the cutoff value for diagnosing diabetes was lowered from 7.8 to 7.0 mmol/L resulting in a larger number of individuals being diagnosed earlier with the disease.[11] The concern with FPG as the primary marker for diabetes is that it only reflective of the blood glucose levels during the last 24 to 48 hours.

The inclusion of hemoglobin A1C measurements in standard screening provides a much more accurate assessment of overall blood sugar control and risk of diabetic complications. A1C is also an effective and convenient independent method for diabetes screening. An A1C cutoff of 5.9% may identify subjects with undiagnosed diabetes as it indicates poor blood sugar regulation and glycosylation, while individuals with A1C ≥5.6% have an increased risk for future diabetes.[12]

Fasting plasma glucose, hemoglobin A1C, and the oral glucose tolerance test (OGTT) all predict diabetic complications yet test reliability is better for fasting plasma glucose and hemoglobin A1C than for the oral glucose tolerance test. Current research recommends that if random plasma glucose is elevated [> or =11.1 mmol/L (200 mg/dL)] and the hemoglobin A1C level is more than 2 standard deviations above the laboratory mean, then diabetes mellitus should be diagnosed, and management should be based on

the hemoglobin A1C level. If the result of only one of these tests is positive, then fasting plasma glucose should be tested to evaluate the patient for impaired fasting glucose and diabetes mellitus. It is suggested that the clinical diagnosis of diabetes mellitus could be streamlined by incorporation of hemoglobin A1C into established criteria.[13]

The Hemoglobin A1C levels are as follows:

- ***normal*** refers to fasting plasma glucose (FPG) concentration <6.1 mmol/L (110 mg/dL)
- ***impaired fasting glucose*** refers to FPG concentration of 6.1-6.9 mmol/L (110-125 mg/dL)
- ***diabetes stage 1*** with a FPG concentration of 7.0 through 7.7 mmol/L (126-139 mg/dL)
- ***diabetes stage 2*** based on FPG concentration criterion of 7.8 mmol/L (140 mg/dL) or higher.

The researchers recommend that diabetes not be diagnosed in those with FPG concentrations < 7.8 mmol/L (140 mg/dL) unless excessive glycosylation is evident. Individuals without excessive glycosylation but with moderate elevations of FPG concentrations (6.1-7.7 mmol/L [110-139 mg/dL]) should be diagnosed as having impaired fasting glucose and treated with an appropriate diet and exercise. This diagnostic labeling achieves the goal of early intervention without subjecting these persons to the potentially negative insurance, employment, social, and psychological consequences of a diagnosis of diabetes mellitus.[14]

As naturopathic doctors it is important for us to provide the best care we can to patients. Fortunately we are not typically bound by the same restrictions as those practioners who have to answer to provincial or insurance-based health care plans. Including additional biomarkers for cardiovascular and diabetes assessment and monitoring are a cost-effective way of improving health outcomes and preventing complications associated with these diseases.

About the Author

Dr. Iva Lloyd BScH, RPE, ND is the founder of Naturopathic Foundations Health Clinic a multi-disciplinary clinic in Markham, Ontario that focuses on the naturopathic and energetic aspects of assessment and treatment. She teaches periodically at the Canadian College of Naturopathic Medicine and she is past-Chair of the Canadian Association of Naturopathic Doctors (CAND).

Dr. Lloyd is the editor in chief of the *Vital Link*, and sits on various other editorial boards. She has written many articles on health related topics for *Energy Currents*, *International Energy*, for the *Healthy Living* magazine and for *Naturopathic Doctor News and Review* journal, as well as other journals. She has been featured in *Chateleine*, *Glow* and other magazines.

She is the author of four books, *Building a Successful Naturopathic Practice*, *Messages From The Body – a guide to the energetics of health, The Energetics of Health, a naturopathic assessment* and *The History of Naturopathic Medicine, a Canadian perspective*.

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Food Allergies and Sensitivities: Observing the Complete Picture

Dr. Marianne Trevorrow, ND, MA
and Tracy Marsden, BScPharm

Diagnosing and treating adverse reactions to foods is a cornerstone of naturopathic practice. About 25% of Canadians believe they have allergic reactions to foods; but according to strict diagnostic guidelines only 8% of young children and 2% of adults in western countries actually experience food allergies *per se*.[1, 2]

Skin prick or 'scratch' testing is often the default method performed in allergy office settings; however it has poor positive predictive value for foods (i.e. many asymptomatic patients have reactions to food allergen extracts). In addition, many patients with either gut-limited immune reactions or delayed-type immune reactions display negative skin prick tests.[3-5] Many NDs then, knowing that elimination diets are challenging for patients, are left wondering what science can tell us about these other reactions, if blood panels are an effective and valid way of establishing these reactions, and how might these tests guide our clinical decision making?

Before addressing these questions, it's important to establish a common nomenclature. In the opinion of the authors, much of the confusion surrounding the efficacy of food reaction testing, and non-IgE tests in particular, has arisen from indiscriminate use of the terms food allergy, food sensitivity and food intolerance. Use of the term 'food allergy' to describe IgG food reactions has created the impression that functional and integrative physicians are equating IgE food allergies with IgG food reactions. This has led critics to dismiss IgG testing as lacking clinical utility because its results do not correlate with IgE tests.[6] Unfortunately, this runs the very real risk of ignoring the relevance of IgG food reactions as a separate clinical condition, plus it discounts the progress that can be achieved through properly designed elimination diets for a variety of challenging health conditions. Additionally, there is emerging evidence that IgA antibody responses to foods may be of clinical significance, and evidence that the classical food allergy response may have a combination of IgE and non-IgE immune-mediated reactions.[3,4] Globally, our understanding of adverse reactions to foods is changing as new information continues to emerge in gastroenterology, immunology and related scientific fields.

After a careful review of recent literature on the immunology of food hypersensitivity responses, we recommend that naturopathic doctors and allied functional and integrative physicians standardize the use of the term *food sensitivity* to describe non-IgE immune mediated reactions. As defined, food sensitivity could be used to describe both IgG and IgA food reactions, although it typically refers to IgG reactions unless otherwise stated. Sensitivity is defined as a "degree of susceptibility", a term consistent with the variability of clinical symptoms associated with IgG and IgA food reactions.[7] *Food sensitivity* would then be the preferred term for immunological reactions not mediated by IgE response. This clearly differentiates IgG and IgA food reactions from the classical definition of food allergy involving IgE response and mast cell degranulation. Furthermore, we suggest that the term *food intolerance* be used exclusively to describe non-immune mediated reactions like enzyme deficiencies (as in the case of lactose intolerance) or chemical reactions.

Per Brandtzaeg, one of the most respected researchers in the area of food allergies, diagrammed the relationship between immune and non-immune reactions in his 2010 *Nature Reviews* paper, adapted below for ND clinical use (with the label *food sensitivity* added to describe non-IgE mediated reactions).[3] We believe using the nomenclature described in Figure 1 (page 34) to distinguish the different types of food reactions helps clarify that food sensitivity is a *distinct* phenomenon, with distinct symptomatology and treatments.

Testing for Food Allergies and Food Sensitivities

In the process of reviewing clinical history, considering allergenic exposures and possible adverse changes to digestive immunity, practitioners may consider blood testing for food allergy or sensitivity as a guide in deciding which foods to eliminate and/or challenge or as a confirmation for presenting symptoms. In conventional circles, the clinical utility of serum ELISA (enzyme linked immunosorbent assay) testing for immediate hypersensitivity (IgE) reactions is well established, while use of this method for delayed hypersensitivity reactions (IgG) remains controversial, if not outright derided. Lavine's article in the Canadian Medical Association journal illustrated this point, declaring that IgG testing is "not a recognized diagnostic tool for food allergy" and suffers from a "paucity of evidence".[6] The CMAJ article, which cited little of the current research on food allergy immunology, received wide coverage in the Canadian popular press.[8] Our argument is

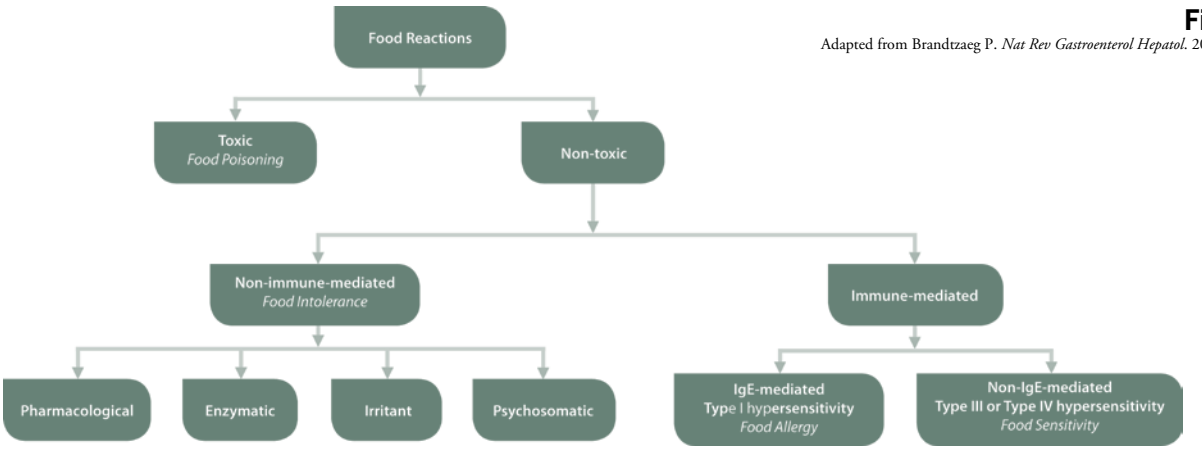

Figure 1
Adapted from Brandtzaeg P. *Nat Rev Gastroenterol Hepatol.* 2010; 7:380-40

that Lavine's assertions about the ineffectiveness of IgG testing for food allergies misses a crucial point: that IgG reactions to food are a distinct clinical condition – an immunological reaction characterized by deposition of antibody-antigen complexes in blood vessels and symptoms appearing hours to days after ingestion of the offending food.[9]

The goal of this current review is to survey the available evidence regarding testing methods for the three main antibody groups (IgE, IgG and IgA) from a scientific as well as a clinical standpoint, and give examples where this testing is of significant utility in the context of appropriate clinical follow up by a skilled naturopathic physician.

Testing for IgE response: deciphering food allergy

Classical food allergy is essentially an IgE response. Although only 0.02% of circulating antibodies are IgE, they can pack a powerful punch, including life-threatening anaphylactic reactions. The half-life of IgE is approximately one day, which means the antibodies disappear from the blood very quickly once exposure has ceased. This can make it challenging to identify acute intermittent reactions as the antibodies may not be circulating in serum long enough to be detected post-reaction.

In an IgE reaction, the high affinity of IgE for receptor sites on the mast cell results in attachment of IgE to mast cells. IgE attachment 'primes' the mast cell, readying it to act quickly if there is a subsequent exposure. When exposure to the same antigen reoccurs, the antigen cross-links to the cell-bound IgE and causes the immediate release of pharmacologically active substances. These inflammation causing chemicals cause fluids to flood into cells, resulting in vasodilation, edema, mucus secretion, smooth muscle constriction, increased pain response, and chemotaxis, all of which can result in symptoms like: sneezing, wheezing, rhinitis, increased mucous secretion, abdominal cramping, angioedema, urticaria and anaphylaxis.[3,9]

The double-blind placebo-controlled food challenge (DBPCFC) is considered the gold standard for diagnosis of IgE food reactions. In a DBPCFC, patients are given capsules every 30 to 60 minutes that contain either placebo or the suspected reactive food. The patient is observed for symptoms, and the test ends when symptoms arise or the allergist concludes that sufficient allergen has been consumed (usually 4 to 8 hours). Due to the possibility of provoking life-threatening anaphylactic reactions, DBPFC is currently only performed in hospitals or allergy specialty clinics, leaving it outside the scope of both naturopathic and conventional primary care medicine.[10]

Skin tests (either intradermal or skin prick) are widely used because of their simplicity, rapid results, low cost, ability to test multiple allergens at one time, and good sensitivity. During a skin test (ST), a small amount of allergen is injected under the skin, and the patient is observed for signs of a reaction (e.g. hives, swelling, redness) at the site of injection. ST is contraindicated in pregnancy, generalized skin disease and with current use of antihistamines.[11] The sensitivity and specificity statistics for ST can vary significantly depending on the allergen extract used, site of testing (forearm, upper back, lower back), and age of patient, which means there is little consensus as to the true reliability of this test.[3]

***In vitro* (blood tests)** are often used when skin tests are contraindicated (e.g. antihistamine or beta blocker use, anaphylactic reaction to previous skin test) or considered impractical (e.g. no access to allergist, unwillingness to submit to test). *In vitro* immunosorbent assays (e.g. ELISA, FEIA, RAST) bind a specific allergen to a solid phase 'sorbent' and then add the patient serum to the solid phase. If antibodies to a specific allergen are present in patient serum, they are detected by an enzyme-linked or radio-labeled anti-human IgE antibody. The quantity of IgE antibody present is measured and expressed as either units of IgE or as a class score. Fluoro-enyzmeimmunoassay (also known as FEIA, ImmunoCAP, or CAP) is rapidly replacing the radio-allergosorbent test (RAST) and appears to be the most accurate *in vitro* IgE test; predicting clinical reactivity in some cases with >95% certainty.[12]

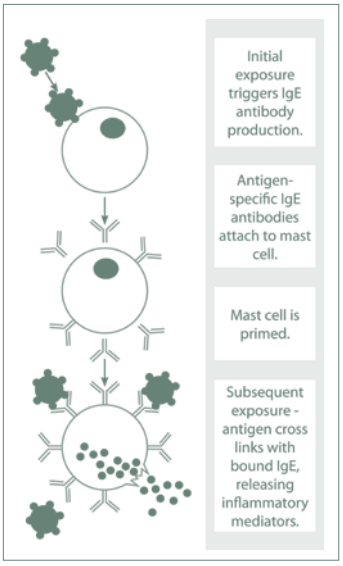

Figure 2

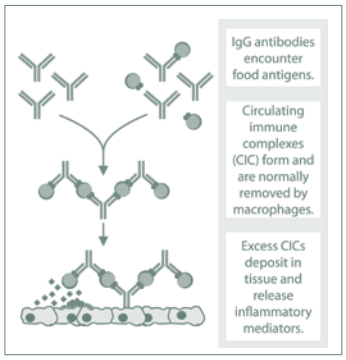

Figure 3

The high sensitivity of the FEIA means that recent exposure to suspected food antigens is not necessary for reactions to be measured. The main disadvantage of the FEIA however, is its high cost, which discourages screening of multiple allergens. Multi-allergen (e.g 96 General Food IgE) ELISA tests are more affordable, but lack the sensitivity of the FEIA and are less likely to identify rapid onset, severe, short duration (i.e. acute) IgE reactions. Multi-allergen ELISA tests appear to be most useful for identifying non-acute IgE reactions to regularly consumed foods.

Total IgE determination in serum may also be a useful diagnostic screening tool in naturopathic practice. According to Sanz et al, atopic adults with Total IgE greater than 1000 kU/L (1000 UI/mL) always have at least one positive specific IgE to a particular antigen.[13, 14] Elevated Total IgE accompanied by clinical symptoms related to allergy suggest the need for specific IgE testing to identify the allergen(s) responsible for these symptoms. That said, Total IgE may also be elevated in parasite infections, Hodgkin's disease, aspergillosis, autoimmune disease and hyper-IgE syndrome.[11]

Deciphering Food Sensitivity

Using the model proposed by Brandtzaeg (Figure 1), the term *food sensitivity* describes non-IgE mediated reactions, which includes IgG and IgA. Since IgG antibodies represent about 75 to 80% of circulating serum immunoglobulins, IgG reactions to specific foods are common. However, it is important to understand that the presence of elevated IgG antibodies to a specific food is not proof of a clinically relevant food sensitivity, just as elevated serum IgE levels are not proof of a clinically relevant food allergy.[15] Similar to IgE, elevated IgG antibodies should be considered in the context of the patient's diet and symptoms. Foods rarely consumed, or consumed on an intermittent basis are much less likely to provoke symptoms. The dose-dependent nature of IgG food reactions means that foods frequently consumed, or those consumed in excess, are most likely to provoke clinically significant symptoms.[9] Symptoms associated with IgG reactions can include: fatigue, digestive symptoms (constipation, diarrhea, bloating, abdominal discomfort etc.), joint pain and stiffness, memory disturbances, and skin conditions.

The mechanism of action by which IgG antibodies to specific foods results in clinical symptoms has yet to be fully defined, however experimental evidence indicates that inflammatory processes appear to be a key element.[16] The immune response that best describes IgG food specific reactions and their relationship to inflammation is the Type III hypersensitivity reaction (see figure 3).[3] In a Type III hypersensitivity reaction, IgG antibodies form to absorbed food antigens and bind with the food antigens to form a circulating immune complex (CIC). CICs are routinely removed by macrophages from the liver, but when excess antigen is present (i.e. food is frequently consumed, or consumed in large quantity), small CICs deposit in blood vessel walls and release inflammatory cytokines that can cause tissue injury.[17] In fact, clinical evidence of the link between inflammation and elevated IgG to specific foods appeared in a study of obese juveniles, which found a tight correlation between elevated food-specific IgG and elevated C-reactive protein, a marker of inflammation.[16] This mechanism offers a possible insight into the reason why IgG elevations are not always clinically significant. Specifically – foods that are consumed in small amounts or infrequently may elicit an IgG reaction, but macrophages are able to remove the CICs and prevent tissue deposition and release of inflammatory cytokines.

Testing for IgG response

There is currently no 'gold standard' laboratory test for food sensitivity, as it is still not a recognized diagnosis. Nevertheless, several laboratory tests are in common use including, but not limited to, the ELISA IgG test and the antigen leukocyte cellular antibody test (ALCAT); known generically as cell size variability method.

The cell size variability test (antigen leukocyte cellular antibody test or ALCAT) is marketed as a chemical sensitivity/food intolerance test. In cell size variability testing, patient blood is combined with the food/chemical or drug. Once sufficient time has passed to trigger the appropriate pathway (e.g. immune, toxic or pharmacologic), changes in the leukocyte size/volume are measured. The mechanism by which foods or chemicals induce this change is not understood, but is believed to involve the release of inflammatory mediators. Unfortunately, no well-designed, peer-reviewed clinical trials have been published that validate the cell size variability method. On the other hand, two published peer-reviewed papers found unacceptably high variability in split samples for the cell size variability method,[18, 19] with one of the investigating teams concluding: "Cell size variability testing for food allergies proved to be completely random in all tests."[19] It is difficult to see how this lack of reliability can lead to useful clinical decision making, although additional peer-reviewed research may provide greater insight into the clinical value of this test.

Enzyme-linked immunosorbent assay (ELISA) for IgG food specific antibodies is the food sensitivity testing method most widely utilized in North America. Unfortunately there is no standard method for testing IgG food sensitivities, with some laboratories isolating and testing the IgG_4 subclass of IgG and others measuring Total IgG (subclasses 1, 2, 3 and 4) to specific foods.

IgG_4 Subclass Testing: Research shows IgG_4 can bind to mast cells and prevent IgE-facilitated activation of T-cells – suggesting that elevated IgG_4 dampens inflammation caused by IgE reactions (i.e. induces tolerance).[20] However, IgG_4 by itself is not considered a likely cause of allergic symptoms, nor is elevated IgG_4 considered diagnostic for food allergy.[20, 21]

Total IgG Testing (Subclasses IgG_1, IgG_2, IgG_3, and IgG_4): Most of the positive clinical research on food sensitivities to date has utilized Total IgG determinations of food specific IgG, and positive clinical data for IgG-guided elimination in several conditions is detailed below:

- **Irritable Bowel Syndrome (IBS):** A landmark study by Atkinson, published in Gut in 2004 investigated IgG food sensitivities in 150 patients with IBS. In this study, patients were tested for IgG reactions to 29 different foods, and then randomized to either a sham diet or a 'true' diet. Both patient and investigator were blinded as to which group was assigned. After 6 weeks, there was a 10% reduction in symptoms and after 12 weeks, a 26% reduction ($p < 0.001$) in the 'true' diet group compared to the sham diet.[22] These findings have been replicated by several other investigators.[23-25]

- **Migraine:** Clinical research suggests IgG food sensitivity may also play a role in migraine headaches. Three peer-reviewed studies have shown significant decreases in migraine headaches when IgG reactive foods were eliminated from the diet.[26-28]

- **Crohn's Disease:** A small randomized, double-blind, six-week cross-over trial by Bentz et al in 2010 investigated IgG food sensitivities in Crohn's disease patients. Crohn's patients in the true diet group experienced an 11% decrease in stool frequency (when true diet was adopted in the first 6 weeks), reduced abdominal pain, and improvement in general well-being compared to the sham diet.[29]

- **Diabetes, Cardiovascular Disease and Obesity:** Both Ahmed and Kohno found that children with insulin dependent diabetes mellitus (IDDM) had significantly higher IgG to specific food antigens than healthy controls.[30,31] A recent study by Lewis et al on obesity found that patients who eliminated

IgG reactive foods from their diet lost nearly 500 grams per week, 7 cm from the waist, and 3.5 cm from the hips over the course of 90 days.[32] And, the Wilders-Truschnig study previously cited found a strong correlation between increased intima media thickness and elevated IgG antibodies to specific foods.[16]

Reliability of Food Sensitivity Testing: The hallmark of a clinically relevant test is one that has high sensitivity and specificity: this means the test is sensitive enough to catch early stages of the disease, and is specific enough that it is not falsely identifying healthy patients as having a disease. The fact that food sensitivity tests are not diagnostic (i.e. disease is not measurable or quantifiable), means that sensitivity and specificity data cannot be determined. Therefore, others measures of reliability must be considered, with reproducibility of results and accreditation by a licensing body being of particular interest.

Reproducibility of IgG results was first called into question by Miller in 1997 when widely different results for the same sample were reported (76%, 29% and 22% of foods reactive) from three different laboratories performing IgG food sensitivity tests.[33] However, a 2010 study comparing ELISA Total IgG from one laboratory to the cell size variability method from another laboratory reported very little variation in split-sample results for ELISA IgG (95% of food reactions were identical and the other 5% within one zone) compared to highly variable results for the cell size variability method (34% of foods were identical, another 28% were within one zone). In a test of consistency of results over time (one week), IgG had a low coefficient of variance (0.05) compared to cell size variability (0.55), which indicates a high degree of reproducibility for IgG ELISA. The intra-class correlation (how strongly points within a group agree with one another) was also highly correlated (0.99) for IgG ELISA compared to cell size variability (0.01).[18] Overall, the Hodsdon study showed that highly reproducible results for ELISA IgG are possible, albeit without specifically considering the issue of inter-laboratory variability.

Laboratory accreditation offers protection to the public by ensuring that external laboratory professionals oversee a laboratory's quality control and quality assurance on a regular basis, and that industry standards are maintained. In Canada, accrediting bodies include the College of Physicians and Surgeons and OLA (Ontario Laboratory Accreditation), while in the United States, accreditation of laboratories is maintained by CLIA (Clinical Laboratory Improvement Amendments) and CAP (College of American Pathologists).

Laboratory testing for IgG reactions is a common tool in naturopathic practice. The following facts should assist NDs in obtaining the most clinically relevant results for their patients:

- The half-life of an IgG antibody is between 23 and 96 days,[9] which makes it challenging to identify reactive foods solely through elimination diets or observation. This also means it can take more than a year for food-specific IgG antibodies to disappear after elimination from diet.
- It takes approximately 30 days to generate an antibody to a specific food if it has been avoided long-term or there has been no previous exposure.[9] Consequently, when a food has been meticulously avoided for six months or more, it may be necessary to reintroduce it six weeks prior to sample collection in order to avoid a false negative result.
- For foods that are consumed regularly or intermittently, two servings of a reactive food twice a week for three weeks prior to sample collection is generally considered sufficient exposure prior to testing for IgG antibodies.[34]
- Because of the high concentration of IgG antibodies circulating in blood, a very small volume of blood (ie the amount in a dried blood spot) can be used to measure antibodies to multiple antigens.
- If several foods in the same family are reactive, it is recommended that other foods in that food family also be eliminated from the diet.[9]
- If IgG testing is impractical, a 6-day elimination of the suspected food, followed by reintroduction on day 7 is suggested. Serum levels of the food antigens will decline over the six days, but IgG antibody levels will remain high. When the suspected food antigen is consumed in significant quantity on day 7 – reactive foods will produce a significant symptom flare as the circulating IgG antibodies react immediately with the food antigen.[34]

IgA testing: GI sensitivity/immune response

Following Brandtzaeg's model (see Figure 1), non-IgE mediated food reactions would also include IgA food sensitivities. Although IgG is the immunoglobulin present in greatest quantity in serum, IgA is the antibody produced in the greatest quantity in normal mucosal tissue, particularly the gut.

The point of the IgA defense system is to *prevent* excessive penetration of both commensal microbes (probiotic or 'good' bacteria) and food antigens though the gut mucosa into the intestinal *lamina propria*. Antigens that do make their way into the *lamina propria* may initially trigger IgG responses and eventually classical systemic IgE responses, in susceptible individuals. Oral *tolerance* to antigens, then, is also part of this IgA system, which is initially established in the neonatal period, as the infant is exposed to microbes and an increasing number of foods.

Research shows that newborns have very little IgA, because they have not been exposed to microbes *in utero.* But, within the first month of life, the number of cells capable of producing IgA increases 75-fold a result of normal exposure to commensal microbes in the environment.[3] This is a crucial point; development of proper mucosal immunity during the first year of life is a combination of colonisation by appropriate microbial colonies in the gut (and other mucosal surfaces including the lungs and nasal passages), and production of IgA immunoglobulins in response.[35] IgA deficiency itself has been linked in numerous studies to food allergy susceptibility in children.[36] This also underlines the potential benefits of rebalancing these microbial colonies with symbiotic therapy (pre- and pro-biotics) in infants who receive antimicrobial therapies for infections.[3]

IgA is an unmistakably important immunoglobulin, but the significance of elevated IgA to specific foods remains unclear. Our current understanding of elevated IgA to specific foods is that it is most likely an indicator of antigen exposure and mucosal damage. For example, elevated gliadin IgA antibodies in a celiac patient is considered a sign of non-compliance with the gluten-free diet, or may be an early sign of mucosal damage caused by undiagnosed celiac disease. The manufacturer of FEIA (fluoro-enzymeimmunosorbent assay) for IgA clearly states that there are no recommended cut-off values for specific IgA antibodies as they are simply markers for antigen exposure and not directly associated with a disease.[37] In other words, elevated IgA to a specific food suggests mucosal damage and possibly loss of oral tolerance. However, with the exception of anti-gliadin IgA, there is no published evidence that global elimination of IgA reactive foods results in clinical improvement of symptoms.

Summary: where do we go from here?

For the naturopathic clinician, the bottom line for diagnosis of food related problems remains (and should remain) a carefully constructed clinical presentation, review of systems, relevant allergen exposures, and consideration of current digestive functioning and healthy bacteria. In this context, ELISA testing for food related reactions can confirm history-related symptoms, and/or serve as a guide to elimination and/or rotation diets. When carefully constructed and with appropriate clinical follow up, these diets are nutritionally sound and relatively simple for patients to follow. Food re-introduction, rather than long-term avoidance, may be a realistic goal if functional mucosal immunity (an IgA response) is restored

and results in increased oral tolerance to established food antigens. Thus, appropriate use of food sensitivity testing can help guide clinical decision making that takes into account the totality of the patient's clinical picture, as well as addressing the underlying causes of many of their presenting health challenges.

About the Authors

Dr. Marianne Trevorrow, ND, MA, completed her ND at Bastyr University in 2006. She spent her post-graduate year as an Assistant Research Investigator in Nutritional Medicine, then relocated to join a private practice on Vancouver Island in 2007. Alongside her integrative-focused family practice, she sees a variety of environmental and developmental disorders in children, including ADHD, autism, asthma and allergies. She is affiliated with Autism Canada and the Autism Research Institute, and is a frequent panellist and speaker on women's health and pediatric environmental health and autism. She is also a director of the BCNA for Inter-Professional Affairs, and a peer reviewer for several CAM biomedical journals, as well as an editorial board member of the *Vital Link*. Contact Marianne at info@drmarianne.ca.

Tracy Marsden, BScPharm, earned both science and pharmacy degrees from the University of Alberta, and holds a Diploma and Fellowship in Homeopathic Pharmacy from the British Institute of Homeopathy. She is a frequent lecturer and writer on natural health and is currently Vice-President of Rocky Mountain Analytical. Contact Tracy at marsden@rmalab.com.

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Medical Imaging: Reasons, Benefits and Risks

Jessica Sangiuliano, ND (Cand.), **Rishi Mehta,** ND (Cand.), **Emily Bennett,** ND (Cand.) and **Aisling Lanigan,** ND (Cand.)

The use of imaging techniques has dramatically increased over the last four years in both Canada and the United States. According to a 2007 report released by the Canadian Institute for Health Information, approximately 419 CT scanners along with 222 MRI machines are currently operational in Canada.[1] The number of machines present in 2003 was 325 and 149 respectively.[1] In addition, the rate of exams (per 1,000 people) has climbed substantially between 2003 and 2007, with 43% of people examined by CT and 28% for MRI scans.[1] In the United States, the number of CT scans performed has increased from 3 million in 1980 to 62 million in 2007, with projections now reaching over 70 million/year.[2] As medical imaging becomes more widespread in healthcare, promoting both patient education and communication is essential. Practitioners and patients must be aware of the reasons, benefits, and risks associated with different types of imaging techniques.

Computed Tomography (CT)

Computed Tomography (CT) was developed in 1972 and has transformed medical imaging by combining specialized X-Ray equipment with sophisticated computers to provide cross-sectional, three-dimensional images of internal organs, bone, soft tissue and blood vessels for diagnosis.[3] Advantages to this method include the elimination of superimposed images of structures outside the area of interest, better clarity of bone pathologies and enhanced images compared to conventional X-ray.[4] It has the ability to illustrate a wide array of disorders including carcinomas (lung, liver, kidney, and pancreas), vascular disease, pulmonary embolism, skeletal abnormalities, and children-specific conditions, such as congenital malformations (heart, kidneys and blood vessels). The use of a CT can also negate the need for more invasive procedures; for instance, CT angiography avoids the insertion of a catheter, and a CT colonography avoids the need for colonoscopy.[4] CT scans can also have a role in the determination of surgeries, and can help decrease hospitalization rates.[4]

REASONS FOR CT OVERUSE

- It has become expected that patients are going to receive an imaging test; therefore patients are tested regardless of whether it is needed[9]
- Physicians may overprescribe to avoid misdiagnosis and possible lawsuits[9]
- Lack of communication between patients, practitioners, and hospitals[6]
- In a recent survey of radiologists and emergency-room physicians, about 75% of the group significantly underestimated the radiation dose from a CT scan[10]

CT has some contraindications, but is generally regarded as safe and inexpensive. The relative contraindications are related to its radiation dose. The radiation dose for a particular application depends on multiple factors including: volume scanned, patient build, number and type of scan sequences, scanning time, type of scanner, and desired resolution and image quality.[5] The radiation dose in a single CT scan is approximately 100 times more potent than a single X-ray, where the organ receives a radiation dose in the range of 15 millisieverts (mSv) (in an adult) to 30 mSv (in a neonate) for a single scan (See Table 1).[6] The ionizing radiation in a CT scan creates ions and hydroxyl radicals in the body that interact with and may damage nearby DNA. When both strands of DNA are damaged, the repair system of the DNA may incorrectly induce point mutations, chromosomal translocations, and gene fusion, thereby increasing the risk of cancer.[7] There is evidence from epidemiologic studies showing organ doses corresponding to a common CT study (a dose in the range of 30 to 90 mSv) resulting in an increased risk of cancer. This is particularly concerning in children who have more years of life during which a potential cancer can be expressed. Children are also more radiosensitive due to their rapidly dividing cells (see Figure 1).[6] As a whole, the relative risk of developing cancer from a single CT Scan is very low, but the problem lies in its multiple uses per patient. These individuals may thereby be continuously exposed to a low-dose radiation which builds in the body over time, increasing risks for cancer.[6] The use of CT is not only used in symptomatic patients, but is being increasingly utilized in asymptomatic individuals (See Table 2). Unfortunately, the weight of evidence from experimental and epidemiological data does not suggest a threshold dose below which radiation exposure may not be harmful and possibly lead to cancer.[8]

In addition to the radiation exposure-cancer link, another risk associated with CT scans is the allergic response to the radioactive contrast dyes (commonly iodine) utilized for enhancing a specific part of an organ. Nausea, vomiting, sneezing, itching, hives and even anaphylaxis have been reported.[3]

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Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging (MRI) is an innovative technique that uses magnetic properties to view structures. It works by measuring the response of a particular body part to radio waves in the presence of controlled magnetic fields. This produces cross sectional images of the part in question in any plane.[11]

MRI is particularly sensitive to soft tissue injuries and neurologic pathologies, but is not suited for dense tissue imaging such as bone. Since the use of a contrast medium is optional with this imaging tool, an MRI may be used in patients with a history of allergy to contrast or when there is compromised renal function.[12] Gadolinium (Gd) compounds are the most common type of contrast agents used. Although toxic in isolation, chelated Gd-DTPA is well-tolerated without risks of severe allergic reaction or nephrotoxic effects at appropriate dosages for diagnosis.[11, 13]

FOR MRI:

- Very useful in diagnosing neurological conditions and soft tissue pathologies
- Not suited for those with retained magnetic foreign bodies, difficulty with holding the breath or severe claustrophobia

MRI is an ideal form of imaging to help evaluate brain pathologies because of a high quality definition, without the presence of bony artifacts.[14] Since an MRI can be performed in any plane, it allows for exceptional precision of lesion localization. This means it can quantify infarct size, screen for hemorrhage after stroke, and diagnose and differentiate hydrocephalus, abscesses or brain tumors.[14,15] The use of a chelated-Gd contrast is especially useful in the diagnosis of neurological disorders by MRI. Under normal circumstances this contrast will not cross an intact blood-brain barrier, but will accumulate if the barrier has been compromised as in a brain abscess, intracranial tumor or from acute demyelination.[11] An MRI with or without contrast is a highly sensitive test for a diagnosis of Multiple Sclerosis (MS). It can be used to identify areas of increased tissue water content found in 90% of MS patients as a result of demyelinated plaques.[16] Use of the Gd-contrast with MRI also allows for differentiation between new and old lesions. MRI can also aid in an accurate diagnosis of Alzheimer's disease by observing structural changes to the medial temporal lobe. This is usually linked and may fall within the Dubois diagnostic criteria of the disease.[15]

Compared to other imaging techniques, MRI provides outstanding soft tissue contrast and is able to evaluate muscle, tendon, ligament, cartilage, and bone marrow pathology. In addition, it can readily aid in the diagnosis of lipomas, hemiangiomas, and tumors that may occur in muscle.[17]

There are some disadvantages associated with an MRI, not entirely obvious. Even though there is no exposure to ionizing radiation, long-term physiological effects have not been established. MRI is considered a relative contraindication in pregnancy, but its lack of radiation makes it ideal in diagnosing maternal and fetal conditions.[14,18] Contrast agents such as Gd can cross the placenta and so are absolutely contraindicated. MRI is not recommended for patients who have retained magnetic foreign bodies, difficulty with breath-holding, or severe claustrophobia.[12,19] MRI is contraindicated for patients with metallic or surgical implants such as skin closure staples or vessel ligation clips. In addition, individuals with cardiovascular implantable electronic devices (CIEDs) such as cardiac pacemakers should not have an MRI. Such metallic articles have caused problems in the past and resulted in severe incidents such as dislodgement, tearing of tissues, and burns.[12,20,21,22] Recent research into reducing the radiofrequency related to the heating of cardiac pacemakers has resulted in the development of "MR conditional" devices. These devices contain significant differences in their function and do interfere with newly implanted CIEDs. This is safe for patients and allows them to take advantage of the diagnostic superiority of MRI for soft tissue pathologies.[21,22]

Positron Emission Tomography (PET)

Positron Emission Tomography (PET) scan came along in 1973 and is an imaging technique used to evaluate the metabolic activity of certain tissues. This procedure typically utilizes a radiotracer, a radioactive substance combined with a natural chemical (glucose, water, or ammonia) that degrades and releases positively charged particles (positrons) inside the body.[23] These particles are detected on a monitor and used to form two- and three-dimensional images with different levels of brightness and colour.

PET scans can help in the diagnosis and treatment of cancer. In patients presenting with a solitary pulmonary nodule unable to have a biopsy, lack of 18fluoro(flu)deoxyglucose (FDG) uptake can effectively rule out malignancy.[23] A PET scan may also be able to show disease recurrence in a variety of cancers including those of the thyroid, germ cells, or colon/rectum. Other conditions in which PET demonstrates value in oncology include to aid surgical resection of non-small-cell lung carcinoma (NSCLC), certain types of lymphoma, as well as staging of aggressive cancers (e.g. gynecologic and some sarcomas).[24] A full list of approved international indications of FDG is shown in Table 2.[25]

Another area in which PET scans may be valuable includes determining the size, shape, position, and function of the heart. This test can help illustrate blockages in coronary arteries, identify areas of ischemia, differentiate between normal and damaged heart muscle and help identify cardiomyopathy.[26] Such information is

PET SCANS IN GENERAL:

- Can be particularly useful in detecting malignancy, heart conditions or neurological disorders
- Poor resolution of scans cannot characterize lesion size and abnormalities less than 1 cm in diameter can be missed
- PET scans carry a risk of radiation exposure and precautions should be taken for expectant mothers

extremely important for those considering angioplasty or coronary bypass surgery.[27]

One other significant role for PET scans involves the assessment of a variety of nervous system disorders, that typically first show alterations in glucose metabolism before the presence of abnormal lesions or shrinkage of brain tissue.[26] This imaging technique may be able to aid in the diagnosis of Alzheimer's disease, Parkinson's disease, dementia, epilepsy, stroke, and Huntington's disease. For example, PET scans are able to accurately pinpoint the seizure focus in epileptic patients and help determine if surgery is viable treatment option.[27]

One of the major clinical disadvantages with PET scans is their lack of specificity in confirming a diagnosis; cells with an uptake of FDG tracer may indicate cancer but could also be a sign of a recent injury, infection, or improper organ function.[28] In addition, PET scans do not effectively resolve the size and shape of a lesion, but mainly the location. Small abnormalities such as those less than 1 cm in diameter can be missed entirely or identified as false positives due to the poor spatial resolution of scans.[29] Another significant problem with PET scans relates to the radioactive isotope used in the radiotracer. Although FDG is short-lived within the body, it does possess the amount of radiation equivalent to 8 mSv.[30] This level of exposure poses a problem for long-term use in patients and should not be recommended as a tool for routine screening purposes. Patients that are pregnant or may become pregnant should be aware of potential injury to the fetus and possible contamination of breast milk with radiotracer. Guidelines suggest that affected milk should be collected and discarded for 2 hours after the scan.[31]

The effectiveness of PET scans will also be affected by high amounts of blood glucose or insulin levels. With excessive glucose, little FDG tracer enter cells due to the vast majority available in the bloodstream. Insulin, on the other hand, encourages glucose to enter cells and results in an increased uptake of FDG tracer. Ultimately, both of these situations can miss an abnormality and glucose levels prior to a scan must be considered. Lastly, allergic reactions have also been reported by some individuals to the injected radiotracer with redness, swelling, and itching noted at site of injection. Anaphylactic reactions have also occurred.

Ultrasound (US)

Ultrasound (US) has been around since 1957 and uses high frequency sound waves to produce an image. Pulses of sound are transmitted into the body and reflections from these structures along the path of the pulse are detected, and combine to form an image. Ultrasound can visualize the size, structure and potential pathology of muscles, tendons and organs and displays the image instantly in real-time.[32]

In comparison with other imaging techniques, ultrasound is significantly less expensive and invasive. Since ultrasound uses high frequency sound, patients are not exposed to the harmful effects of ionizing radiation. Ultrasound produces a dynamic, real time image and can be useful in guiding other medical interventions; such as fine needle aspiration, core needle biopsy, and endovenous laser treatment. In addition, ultrasound is extremely useful for soft tissues imaging and can help visualize cardiac, renal, hepatic, musculo-skeletal, gastrointestinal, reproductive and ophthalmic systems. Additionally, superficial structures such as the testicles, thyroid, salivary glands and lymph nodes can be identified and characterized. The Doppler effect in some types of ultrasound allows a measure of blood velocity and map blood flow for the assessment of cardiovascular health and the prevention of myocardial infarctions, thromboembolism and stroke.

FOR ULTRASOUND:

- Has a wide variety of therapeutic applications ranging from imaging to high and low intensity ultrasound
- Newer ultrasound devices can be far more powerful and must be used with caution in newer applications of medicine
- Limitations include lack of resolution and depth of penetration.

In addition to its use as a diagnostic tool, the ultrasound has many therapeutic applications, which can be highly beneficial when used within dosage precautions. Examples of the therapeutic uses for US include:

- High Intensity Focused Ultrasound (HIFU) in tumor ablation, lithotripsy and cataract treatment
- Low Intensity Focused Ultrasound (LIFU) in tooth and bone regeneration
- Acoustic Targeted Drug Delivery (ATDD) to enhance chemotherapy drug delivery to brain cancer cells

Obstetric ultrasound can be used during pregnancy if there is concern for the health of mother and fetus. Fetal ultrasounds are excellent in determining an abnormality or multiple births.

When compared with other imaging techniques, the main disadvantage of the ultrasound is in the image resolution. The ultrasound acquires images at a high rate in real time and this can lead to speckling, distortion and shadowing. The ultrasound also has a limited depth of penetration, reaching about 3 cm at its highest resolution. Skilled and experienced technicians tend to obtain better images; however, this is becoming less common as ultrasound devices become more user friendly.

The two main side effects of ultrasound can be separated into thermal and non-thermal effects.[33] As ultrasound enters the body, it results in a slight increase in temperature due to molecular friction. The non-thermal side effects are associated with a release of energy in the form of a mechanical pressure wave that occurs through soft tissue. This pressure wave may cause microscopic air pockets in living tissues which expand and collapse, a process called cavitation. This can lead to a disruption in cell membranes and potentially cause an acute inflammatory reaction. Tissues which contain stabilized gas bodies, such as the lungs and gastrointestinal tract, are at increased risk of non-thermal ultrasound damage.

The World Federation for Ultrasound in Medicine and Biology (WFUMB) has established international guidelines indicating a temperature elevation threshold of 1.5°C for clinical use in obstetrics.[33] Fetal temperatures exceeding 4°C for 5 minutes have been shown to induce severe developmental defects.[34] Other evidence regarding the harmful thermal effects of ultrasound have been largely based on a variety of in utero animal studies in which musculoskeletal, and central nervous system abnormalities were primarily observed.[35,36,37] This is potentially problematic as new and improved ultrasound devices become increasingly applied in healthcare; for instance, the use of Doppler ultrasound in obstetrics has the potential to increase fetal temperatures up to 4.9°C in 2 minutes of exposure.[33] This questions both the safety profile as well as the long term effects with newer devices.

Conclusion

The use of medical imaging techniques has transformed healthcare over the years, providing tools for better visualization, accurate diagnosis and determining proper treatment for a variety of disorders including that of the neurological, cardiovascular, gastrointestinal, reproductive, endocrine, respiratory, musculoskeletal and immunological systems. However, it is vital to the health and wellbeing of patients, as well as the healthcare system, to be properly informed about the use, benefits and risks associated with each imaging technique. More importantly, communication between patients, practitioners, and healthcare facilities is essential to help reduce the use of repetitive testing, minimize the risks associated with each technique.

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1851 – Ophthalmoscope

1895 – X-ray

1957 – Ultrasound

1972 – CT Scan

1973 – PET Scan

1977 – MRI

Source: *The History of Naturopathic Medicine, A Canadian Perspective*

IMPROVING THE USE OF IMAGING RESOURCES

- Replace the use of ionizing-radiation techniques, if practical, with other techniques which pose less of a risk of DNA damage.[6]
- Apply the As Low as Reasonable Achievable (ALARA) Principle when utilizing imaging techniques, especially in those with radiation.
- Use imaging modalities efficiently, and try to avoid radiation exposure in children who are more radiosensitive.
- Properly inform patients about the benefits and risks of scanning.[9]
- Communicate with previous practitioners and hospitals, and address previous scans before making decisions to repeat imaging
- Consider the patient's exposure to radiation in the past, especially the specific body part in question.[9]
- Take a thorough history and decide if imaging is in the patient's best interest.

Tables and Figures

Table 1: Typical Organ Radiation Doses from Various Radiologic Studies

STUDY TYPE	Relevant Organ	Relevant Organ Dose*(mSv)
Dental radiography	Brain	0.0005
Posterior-Anterior Chest radiography	Lung	.01
Lateral Chest Radiography	Lung	0.15
Adult abdominal CT	Stomach	10
Neonate abdominal CT	Stomach	20

*The radiation dose, a measure of ionizing energy absorbed per unit of mass, is expressed in sieverts (Sv) or millisieverts (mSv)

Adapted from Brenner and Hall, 20076

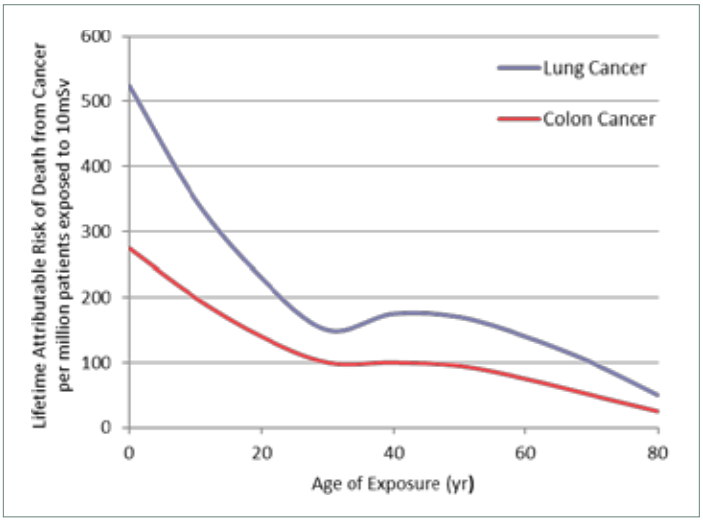
Table 2: Approved International Indications for Clinical Use of 18F-FDG

	USA	EU	Australia	Alberta
Brain			E	R
Breast	S, R, M			R
Colorectal	D, S, R	E, M	S, R	R
Head and Neck	D, S, R	A		S, R, A, M
Lung	D, S, R	D, A, E	E, S	D, S
Lymphoma	C, D, S, R	A, D		
Melanoma	D, S, R	A	E	A, R
Thyroid	R			
Cervix			S	
Esophagus	D, S, R		S	S
Ovary			E	
Stomach			S	

Legend: A = assessment, C = characterization, D = diagnosis, R = re-staging, E= evaluation, M = monitoring, S = staging

Adapted from Pearcy R., Mcewan A, 2006-200725

Figure 1: Estimated Dependence of Lifetime Radiation-Induced Risk of Cancer mortality dependent on Age of Exposure for Lung and Colon CA



About the Authors

Jessica Sangiuliano, ND (Cand.) is a clinical intern at the Robert Schad Naturopathic Clinic in Toronto, Ontario. Her focus is in General Family medicine and Pediatrics, and is currently developing an integrative medical clinic with focus in Women's Health, Pediatrics and Family Medicine. She is an active member of the CAND, OAND, AANP, OncANP, and PedANP, and has worked alongside various practitioners throughout Ontario and in Kenya, Africa. She continues research in areas of oncology, pediatrics, fertility, and overall health maintenance.

Rishi Mehta, ND (Cand.) is currently a naturopathic student at the Canadian College of Naturopathic Medicine (CCNM). Before attending CCNM, he completed his Bachelor of Science degree at the University of Guelph and developed an interest in both biological and nutritional sciences. Rishi has worked alongside with many medical and naturopathic doctors in the areas of general care and oncology. He has also lectured to students and other healthcare practitioners on a variety of health topics ranging from pediatric nutrition to supportive care in cancer patients.

Emily Bennett, ND (Cand.) is also a naturopathic student studying at the Canadian College of Naturopathic Medicine. She has an extensive background in Geography and Philosophy with an interest in providing accessible naturopathic care in a community setting.

Aisling Lanigan, ND (Cand.) is a recent graduate of the doctor of naturopathic medicine program from the Canadian College of Naturopathic Medicine. She also holds a Bachelor of Science Honors in Kinesiology from the University of Ottawa. After completing the NPLEX board licensing examinations she plans to open a practice in downtown Toronto with a focus on one of her two passions, women's health and fertility, or oncology.

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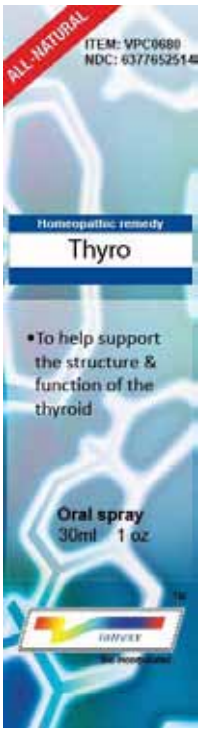

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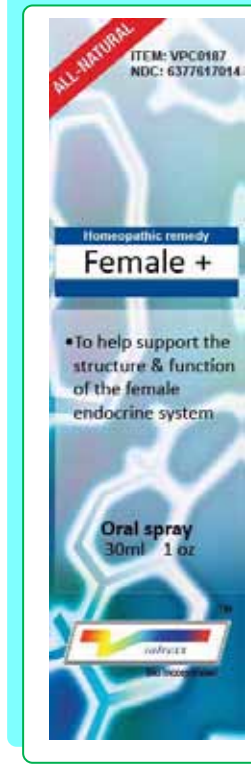

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