College of Dietitians of Ontario

Tel: 416.598.1725
Toll Free: 800.668.4990
Fax: 416.598.0274

5775 Yonge Street
Suite 1810, Box 30
Toronto, ON M2M 4J1

www.collegeofdietitians.org

March 1, 2018

Via Email

Allison Henry, Director
Health System Labour Relations and Regulatory Policy Branch
Health Workforce Planning and Regulatory Affairs Division
Ministry of Health and Long-Term Care
56 Wellesley Street West, 12th Floor
Toronto ON M5S 2S3
Allison.Henry@ontario.ca

Dear Ms. Henry,

We are pleased to include our 2018 supplementary response to the Ministry of Health and Long-Term Care's request for information regarding the proposed scope of practice expansion to permit Registered Dietitians to directly order laboratory tests in support of nutrition care assessment and monitoring.

The College of Dietitians of Ontario appreciates the opportunity to work with the Ministry in helping to achieve its *Patient's First: Action Plan for Health Care*. We would like to thank the Ministry staff who met with us in preparation of this supplementary response.

We trust this submission provides the requested supplementary information. However, if there is any additional information required or if there are any further questions, please do not hesitate to contact me at melisse.willems@collegeofdietitians.org or 416-598-1725 ext. 228.

Sincerely,

M. Willems

Melisse L. Willems, MA, LLB
Registrar & Executive Director

Encl.

Review of College of Dietitians Submission Re: Proposal for Registered Dietitians to order laboratory tests

General Comments

1. The proposal requests that RD authority be extended to order all laboratory tests available in Ontario. The key reason given for adopting a broad authority vs. submitting a list of test is that testing technology changes rapidly over time and that a list-based approach can be cumbersome and slow to respond to the introduction of new tests with higher specificity/sensitivity.
2. The ministry has identified two key issues with this proposed approach and its reasoning:
    a. The approach would grant access to tests that do not appear relevant to the practice of dietetics and nutrition management.

Like all regulated health professionals in Ontario, Dietitians practice the profession according to the scope of practice statement and authorized controlled acts as defined in the *Dietetics Act, 1991.* If the authority for Dietitians to order laboratory tests for nutrition assessment and monitoring proceeds, Dietitians would be expected to continue to practice within scope and adhere to the College's *Standards of Professional Practice for Ordering Laboratory Tests for Nutrition Assessment and Monitoring*. The standards currently articulate: "Unless a laboratory test will provide a result specific to nutrition assessment and monitoring the test may not be ordered by Dietitians."

Dietitians, like the other professions with broad ordering authority, will be required to practice within scope when ordering laboratory tests.

    b. It is not accurate to describe the current listing method as unable to respond to new and improved tests, as the listing of laboratory tests is done on the basis of categories (either type of test or molecule/marker being tested) and not individual tests.

The College is requesting the Ministry to proceed with granting laboratory test ordering authority for Dietitians without the need for a laboratory test list outlined in regulation. Please refer to our December 2017 submission for the rationale for that request.

Please refer to the attached 2018 list of laboratory tests as requested for the Ministry's cost forecasting purposes. The list of laboratory includes revisions to the laboratory test list submitted by

our College to the Ministry in 2011. Revisions are based on feedback received from Dietitians in our 2017 member consultation.

3. The MESPO framework requires that claims be supported by evidence. An evaluation using MESPO follows these steps:
    a. Determination of patient or system need for the expanded scope.
    b. Impact assessment, along the following pillars:
        i. Impact to patients
        ii. Impact to the health system
        iii. Economic impact
        iv. Impact to interprofessional care
        v. Patient safety impact
        vi. Professional competencies

Specific Comments

1. About the proposal
    a. The ministry is seeking further details regarding the daily practice of dietetics in Ontario, specifically which are the laboratory tests commonly used to evaluate metabolic and biochemical functions dependent on the adequate supply of essential nutrients (i.e. commonly used in nutrition therapy and management)?

Please refer to the attached 2018 list of laboratory tests.

2. Impact on timeliness to care
    a. The college notes that the proposal would have a positive impact on timeliness to care and greater ease of navigation, and that these impacts are key contributions to cost-containment and improving quality of care (pages 8-11). To better illustrate these statements, what is the **typical** patient pathway for receiving an order for a blood test relating to nutritional management and therapy in:
        a. An institutional setting (hospital or LTCH) where a medical directive is in place allowing RDs to order specific laboratory tests?

Dietitians order the laboratory tests through the patient's electronic medical record (EMR), paper chart or another lab test ordering system. The sample (e.g. blood, urine, fecal) is drawn by an authorized practitioner (e.g. laboratory technologist or nurse) and sent to the laboratory for analysis.

Results are included in the EMR, paper records or in a specific lab test results location (if kept separately). Dietitians discuss the results with the patient's most responsible physician/nurse

practitioner (NP), as applicable. Modifications to the nutrition care plan are implemented if the Dietitian has the authority to order diets/oral nutritional supplements/vitamins and minerals. If no ordering authority for diets/supplements exists, the Dietitian requests the most responsible physician/NP to modify the nutrition care plan accordingly.

Note that while long-term care (LTC) homes are not subject to section 24 (Orders for Treatment) under the Hospital Management Regulation of the *Public Hospitals Act, 1991*, many LTC homes operate in a similar manner (via organizational policy) requiring the most responsible physician/NP to co-sign any diet/supplement orders. Where this is not the case, Dietitians can freely order diets/supplements without any additional authority in LTC homes.

b. An institutional setting (hospital or LTCH) where there are no medical directives in place allowing for specific laboratory tests?

Dietitians have a discussion and/or make written/oral suggestions to the most responsible physician/NP to order the specific laboratory tests for nutrition assessment and monitoring. If in agreement, the physician/NP then orders the laboratory tests and the sample (e.g. blood, urine, fecal) is drawn by an authorized practitioner (e.g. laboratory technologist or nurse) and sent to the laboratory for analysis.

Results are included in the EMR, paper records or in a specific lab test results location (if kept separately). Dietitians discuss the results with the most responsible physician/NP, as applicable. Modifications to the nutrition care plan are implemented if the Dietitian has the authority to order diets/oral nutritional supplements/vitamins and minerals. If no ordering authority for diets/supplements exists, the Dietitian requests the most responsible physician/NP to modify the nutrition care plan accordingly.

Note that while long-term care (LTC) homes are not subject to section 24 (Orders for Treatment) under the Hospital Management Regulation of the *Public Hospitals Act, 1991*, many LTC homes operate in a similar manner (via organizational policy) requiring the most responsible physician/NP to co-sign any diet/supplement orders. Where this is not the case, Dietitians can freely order diets/supplements without any additional authority in LTC homes.

c. In a primary or community care setting (e.g., FHT, CHC, Home care agency)?

With Medical Directives:

Dietitians complete the laboratory requisition form to order the laboratory tests and indicate accordingly what was ordered in the patient's EMR or paper chart. The patient takes the requisition form to their local laboratory to have the laboratory tests drawn. The laboratory knows the Dietitian has such authority to order laboratory tests by either the attached copy of the medical directive to the patient's laboratory requisition form, or the laboratory has this medical directive already on file. The sample (e.g. blood, urine, fecal) is drawn by an authorized practitioner and sent to the laboratory for analysis.

Results are sent to the Dietitian and primary care provider (if CC'd on the laboratory requisition form) and included in the patient's EMR, paper record or in another specific lab test results location (if kept separately). The Dietitian discusses the results with the primary care provider, as applicable. Modifications to the nutrition care plan are implemented accordingly.

Without Medical Directives:

Dietitians have a discussion and/or make written/oral suggestions to the primary care physician/NP to order the specific laboratory tests for nutrition assessment and monitoring. If in agreement, the physician/NP then orders the laboratory tests and provides the patient with the requisition form. The patient takes the requisition form to their local laboratory to have the laboratory tests drawn. The sample (e.g. blood, urine, fecal) is drawn by an authorized practitioner and sent to the laboratory for analysis.

Results are included in the patient's EMR, paper records or in another specific lab test results location (if kept separately). The Dietitian reviews the laboratory test results once included in the EMR or paper chart and discusses the results with the primary care provider, as applicable. Modifications to the nutrition care plan are implemented accordingly.

b. How would the proposed scope of practice change alter the typical patient pathway in each of the scenarios described above?

In 2a, the pathway would remain the same but there would be no need to create and annually approve medical directives giving Dietitians the authority to order laboratory tests for nutrition assessment and monitoring. This would alleviate a significant amount of time and health care practitioner resources in the development and approval process. Patients would receive nutrition care in a more timely and convenient manner.

In b and c, the pathway would resemble what was outlined in 2a. There would be no need to make suggest orders to physicians/NPs which can often take time (in some cases days) and requiring patients to attend additional appointments in FHT, CHC, and homecare settings.

In all cases, Dietitians are expected to collaborate and communicate with physicians/NPs. This requirement is well articulated in the College's Council-approved *2011 Standards of Professional Practice for Ordering Laboratory Tests for Nutrition Assessment and Monitoring*. Refer to copy of standards provided by email to the Ministry on February 8, 2018.

3. Patient Safety
    a. Please provide a copy of the *Standards of Professional Practice for Ordering Laboratory Tests for Nutrition Assessment and Monitoring*

This document was emailed to the Ministry on February 8, 2018. Also attached here for your ease of reference.

    b. On page 12, the college notes that access to electronic health records is a key element enabling effective inter-professional communication. What percentage of your membership has access to electronic health records in their primary place of work?

The College is unable to answer this question. It is possible that the Ministry can obtain some data through the analysis of the publically-funded facilities which have granted Ontario Laboratories Information System (OLIS) access to Dietitians.

    c. Has the college contemplated whether there is a need for a mandatory reporting requirement to the patient's Primary Care Provider by an RD of the results of a laboratory test ordered by the RD?

The College's 2011 Standards of Professional Practice for Ordering Laboratory Tests for Nutrition Assessment and Monitoring require collaboration and communication between RDs and others providers for client care. If the authority for Dietitians to order laboratory tests proceeds, the College will consider whether a specific statement in the standards is needed requiring Dietitians to share the results of the laboratory tests they order with the patient's primary care provider.

4. Education and competency
    a. On page 13, the college notes "Overall, dietitians have the necessary entry-level competence to order, interpret and appropriately utilize specific laboratory tests for nutrition assessment and monitoring." (emphasis added). Please identify which laboratory tests dietitians have the necessary entry-level competence to order, interpret and appropriately utilize. Consider surveying RDs about entry level practice vs. advanced practice lab tests?

Refer to 2018 revised laboratory test list provided.

    b. The college notes its confidence in entry-to-practice competencies (p.14). Can the college comment on the competencies of RDs that are currently in practice and have been in practice for 10 years or more, and on its mechanisms/activities to ensure the competency of these members to perform the new proposed authority? RDs currently ordering labs through medical directives, skin pricking?

As per page 13 of the College's December 2017 submission to the Ministry, the Integrated Competencies for Dietetic Education and Practice (ICDEPs) are listed that correspond to ordering laboratory tests. The ICDEPs have been in place for Dietitians in Ontario since 2013. Prior to the ICDEPs, the following competencies corresponding to ordering laboratory tests were in place:

2006 Essential Competencies for Dietetic Practice

DIMENSION 1: PROFESSIONAL PRACTICE

1.0 Practices with professional integrity.
1.1 Practices in compliance with professional legislation and regulations.
1.2 Practices in compliance with professional standards, practice guidelines and codes.
1.4 Refers individuals for consultation when issues are beyond scope of practice and competence.
1.5 Accepts personal responsibility and accountability for actions and decisions.

2.0 Respects the individuality and autonomy of others.
2.3 Obtains informed consent as required prior to providing services.
2.4 Provides services considering the best interests of the individual and their needs.

3.0 Applies legal and ethical principles in managing information.
3.1 Complies with legislation and established policies in managing information.

4.0 Applies information management principles and current technology in practice.
4.1 Documents and maintains information in compliance with established guidelines.
4.2 Maintains accurate, clear, concise and timely documentation of professional services.

DIMENSION 2: COMMUNICATION

8.0 Facilitates team work.
8.1 Applies principles of collaboration and negotiation in team work.
8.2 Incorporates team members' knowledge, expertise and personal skills in team processes.
8.3 Collaborates with team members to determine goals.

DIMENSION 3: COMPETENCE

10.0 Maintains professional competence.
10.1 Reflects on and evaluates own current practice.
10.3 Recognizes limitations in practice qualifications and own level of competence.

12.0 Applies current research and evidence based practice findings into services provided.
12.1 Evaluates current research / evidence based practice findings to determine the reliability and credibility of information.
12.2 Determines applicability of current research / evidence based practice findings to practice setting.
12.2 Applies research / evidence based practice findings to improve practice.

DIMENSION 4: CLIENT CARE

16.0 Contributes to client care through collaboration with inter-professional team.
16.1 Advocates on behalf of clients with the inter-professional team.
16.2 Coordinates and integrates care to ensure quality and continuity of care.
16.3 Refers clients to other members of the inter-professional team.

17.0 Conducts comprehensive nutrition assessments.
17.7 Reviews and assesses relevant laboratory data.
17.9 Interprets findings of comprehensive nutrition assessment to identify normal, abnormal and deviant states of health.
17.10 Draws relevant conclusions from nutrition assessment data.

18.0 Develops, implements and evaluates nutrition care plans.
18.1 Integrates assessment data in development of the nutrition care plan.

1996 – Competencies for the Entry-Level Dietitian

Professional Practice

- 3. Commits to a high standard of professional competence through continuous learning and self-development by:
  - a) assessing personal and professional strengths and limitations.
  - b) identifying development needs in practicing dietetics.
  - c) pursuing a plan for self-development.
  - d) monitoring a plan for self-development.

- 6. Accepts accountability in performing responsibilities.
- 7. Practices within areas of competence.
- 8. Utilizes research to improve practice.

Assessment

- 2. Identifies/obtains relevant data including:
  - c) health record data (e.g. anthropometric, biochemical, clinical, dietary, psychosocial).
- 6. Integrates and interprets:
  - c) health record data (e.g. anthropometric, biochemical, clinical, dietary, psychosocial).

Planning

- 1. Establishes, with the client and appropriate others, realistic goals consistent with the assessment, ethical considerations, legislation, and policies.

Communication

- Collaborates with clients, colleagues, agencies, etc. during all phases of practice (e.g. assessment, planning, implementation, and evaluation).
- Uses appropriate communication
- 14. Documents at each stage of the process:
  - a) according to policy, established time lines, and legal requirements.
  - b) in an appropriate format (e.g. concise and organized style).

c. On page 15, the college notes "Should the authority for dietitians to order laboratory tests for nutrition assessment and monitoring proceed, we will also explore changes to CDO's Quality Assurance Program to capture this new authority". The ministry would

encourage the college to identify the quality assurance activities it would undertake to ensure continued safety and quality of care, as part of this proposal.

Quality Assurance Program

If the authority for Dietitians to order laboratory tests for nutrition assessment and monitoring proceeds, the College will incorporate a means through its existing Quality Assurance (QA) Program components (subject to Committee and Council approval, as appropriate) to:

1. Collect data (number of Dietitians ordering labs);
2. Encourage professional development for safe and competent performance of this new authority; and
3. Ensure understanding and compliance of the legislation and the College's standards for ordering laboratory tests for nutrition assessment and monitoring.

As with any other authority given to Dietitians through legislation (e.g. point of care testing) and in keeping with its mandate of public protection, the College will not become the arbiter of specific logistical and workplace processes within a Dietitian's practice. High level behavioural expectations for Dietitians would be articulated in the *Standards of Professional Practice for Ordering Laboratory Tests for Nutrition Assessment and Monitoring.*

Subject to the approval of the QA Committee and Council, as appropriate, the College could consider the following QA program activities to ensure continued safety and quality care when Dietitians order laboratory tests for nutrition assessment and monitoring:

1) Data Collection

The Self-Directed Learning (SDL) Tool is completed annually at renewal by all active General members; it is the means by which members reflect on their current practice and set two professional development goals related to their learning needs.

We will incorporate a question into the SDL Tool which asks members: *Do you currently order laboratory tests for nutritional assessment and monitoring?*

The data would then be analyzed to determine the number of Dietitians actually ordering laboratory tests in their dietetic practice.

The College reviews a selection of learning goals every year to ensure they are appropriate.

2) Professional Development

If members respond yes to the previous question as proposed in the SDL Tool, the College would encourage them to develop one of their learning goals related to ordering laboratory tests, especially for those members who are fairly new at independently ordering laboratory tests in their dietetic practice.

The data would then be analyzed to determine the number of Dietitians who have chosen to develop a learning goal around this practice.

The College reviews a selection of learning goals every year to ensure they are appropriate.

3) Ensure understanding and compliance of the legislation and CDO's standards for ordering laboratory tests for nutrition assessment and monitoring

a) The Jurisprudence Knowledge Assessment Tool (JKAT) is completed by every member within their first year of General membership and every five years thereafter; it is a multiple choice, open book online "test" to ensure that members have an understanding of the legislation, standards and by-laws impacting the dietetic profession in Ontario. Every member must achieve 90% and they have three attempts to achieve the "pass" mark.

   Each of the questions within the JKAT describes a scenario and the member must choose the most appropriate answer; references are given to assist in answering the questions correctly. The questions run the gamut from professional ethics to record keeping to performing controlled acts, etc.

   We will incorporate two to three questions in the JKAT related to the authority for Dietitians to order laboratory tests for nutrition assessment and monitoring. References will be given to corresponding legislation, standards of practice and other College educational resources, as applicable.

   The results would be tabulated and the development of further educational resources would be undertaken by the College on an as-needed basis.

b) The 2 Step Peer and Practice Assessment (PPA) is completed annually by a random selection of 10% of General members; Step 1 is a multisource survey from patients*, colleagues and a member self-survey. Based on Step 1 results and other defined criteria, some members are required to move onto a chart review of patient health records and a behaviour-based interview

regarding their dietetic practice performed by a trained peer assessor familiar with the Dietitian's area of practice.

Albeit a small portion of the membership, for those members moving onto Step 2 of the PPA, the College will incorporate a question in the pre-assessment survey regarding laboratory ordering practices. In the behaviour-based interview, we would then ask the Dietitian being assessed to describe their procedure(s) for ordering laboratory tests, including documentation and mechanisms to ensure effective interprofessional collaboration and communication.

* Patients are defined as individuals, caregivers, family members, substitute decision-makers who: a) have received care within the last year; or b) are currently receiving service.

5. Economic Impact
    a. The ministry will need to undertake cost-modelling relating to this proposal in order to determine its impact on the public budget, businesses in Ontario and patients. In order to do this, the ministry will require a list of tests used in RD practice for nutrition therapy and management.

Refer to the 2018 revised laboratory test list provided.

6. Consultation activities
    a. Consultation is a key process encouraged by the ministry for all proponent of a scope of practice change. The information gleaned from consultation activities can help inform answers to questions relating to the impact of the proposal on patients or the health system, on other Ontario Businesses, on inter-professional care delivery, and quality of care. Moreover, these activities can identify risks and issues that will need to be mitigated.

    b. On pages 19 and 20 of the submission, the College notes that at the time of submission to the ministry, it had not heard feedback from the OHA on the current proposal. If a response was received from the OHA, please provide it to the ministry.

The College sent a follow-up email to the Ontario Hospital Association (OHA) on February 22, 2018 to determine if they have any questions or comments. The OHA responded and indicated they have already been in contact with the Ministry directly about this work and will be following-up directly with Ministry staff.

c. The college survey of its members indicates that many dietitians also work in Long-Term Care Facilities, Diabetes Education Centres, Family Health Teams and Community Health Centers. As such, the ministry would encourage the college to consult on this proposal with the following organisations: Ontario Long-Term Care Association, the Association of Family Health Teams of Ontario, and the Association of Ontario Health Centers.

Our December 2017 submission to the Ministry was emailed to the following organizations requesting input:

- Ontario Long-Term Care Association – February 20, 2018
  - Note that the Ontario Long-Term Care Association participated in the original consultation in 2008 (see attached) and were supportive of the change of scope being requested. In response to the recent consultation request, the Association indicated on February 26, 2018 that they will not be responding due to time constraints.

- Association of Family Health Teams of Ontario – February 21, 2018
  - No response to date March 1, 2018.

- Association of Ontario Health Centres – February 21, 2018
  - On February 23, 2018, they emailed the College indicating they will try to share a written response by March 1, 2018.

d. On page 21, the college notes that it has not consulted with members of the public on this proposal. If consultation activities took place since the submission of this proposal, please provide a summary of the feedback and comments received. If no consultation activities have taken place, the ministry encourages the college to do so.

The College has developed a public consultation survey which is being disseminated via our website, Facebook page and Twitter account. To access the consultation survey, click here.

Preliminary results to date March 1, 2018 from 22 respondents indicates that the majority of respondents (91%) are in favour of the proposed authority for Dietitians to order laboratory tests for nutrition assessment and monitoring and 96% felt the proposed change would improve the patient experience.

e. On page 23, the college notes that at the time of submission to the ministry, it had not heard feedback from all members of the Federation of Regulatory Health Colleges of Ontario on the current proposal. If additional responses beyond those included in the submission have been received since, please provide them to the ministry.

Nothing further to date as of March 1, 2018.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
VITAMINS		
Retinol	- Retinol is measured to determine Vitamin A status. - Vitamin A is required for adequate vision; absorbed in small intestine. - Patients that have undergone *bariatric surgery* often encounter changes in fat digestion and malabsorption of fat-soluble vitamins; assessed post-operatively to determine deficiency and compliance with multivitamin/mineral supplements. - Assessed in combination with iron and copper as deficiencies in these minerals can impair vitamin A levels. - Low levels seen in smokers and patients with *Cystic Fibrosis*; high levels seen post-surgery in lung transplant patients with *Cystic Fibrosis*.	- Educate patients on foods containing high vitamin A to increase dietary intake. - Recommend patients take oral vitamin A supplements. - Supplement/adjust vitamin A in *Enteral Nutrition* (EN) or *Parenteral Nutrition* (PN). - Assess iron and copper levels.
Serum Vitamin B1 (Thiamine)	- Thiamine helps the body convert carbohydrates into energy and is imperative for proper glucose metabolism, essential for the functioning of the heart, muscles, and nervous system; absorbed in middle section (jejunum) of small intestine. - Monitored to rule-out/prevent Beriberi: a nervous system ailment caused by thiamine deficiency. - As jejunum is bypassed in some patients that have undergone *bariatric surgery*; malabsorption of thiamine may occur. - Monitoring this lab identifies deficiencies and compliance of multivitamin supplementation post-operatively. - Thiamine deficiency seen in patients with excessive alcohol consumption and in breast fed infants whose mother is thiamine deficient. - Patients with folate or protein deficiency often have poor thiamine absorption. - Malnourished patients at risk for refeeding syndrome are usually low in water soluble vitamins, most commonly thiamine.	- Educate patients on foods containing high thiamine to increase dietary intake. - Recommend patients take oral thiamine supplements. - Supplement/adjust thiamine in EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Vitamin B3 (Niacin)	- Assists in the functioning of the digestive system, skin, and nerves; important for the conversion of food to energy. - Niacin can be used in patients who are not tolerating statin cholesterol-lowering mediations; works by slowing the liver's production of Low-Density Lipoprotein (LDL) (the bad) cholesterol and also raises High-Density Lipoprotein (HDL) (the good) cholesterol. - Deficiencies uncommon; monitored in patients taking supplements for cholesterol management to screen for high levels that can be toxic to the liver.	- Collaborate with physician re: need for (or adjustment to) niacin vitamin supplementation for cholesterol management. - Educate clients on appropriate oral niacin supplementation and dietary sources of niacin to increase intake. - Supplement/adjust EN or PN.
Serum Vitamin B12 (Cobalamin) [L345]	- Involved in the metabolism of every cell of the human body, especially maturation of red blood cells, DNA synthesis and regulation, fatty acid synthesis and energy production; requires gastric acid and intrinsic factor (secreted naturally by the stomach) for absorption. - Vitamin B12 deficiency can lead to pernicious *anemia*, neurological and neuromuscular disorders and failure. - Patients that have undergone *bariatric surgery*, *gastrectomy* patients and the elderly often experience low gastric acid production which is required for release of vitamin B12 from protein foods; these populations also experience decreased intrinsic factor production leading to decreased vitamin B12 absorption. - Vitamin B12 deficiency also seen in genetic disorders of vitamin B12 metabolism, chronic kidney disease, *inflammatory bowel disease* (Crohn's disease and Ulcertive Colitis), *Celiac disease*, congestive heart failure, those consuming a vegan diet and athletes. - Vitamin B12 deficiency can be masked by high folate levels; often checked along with folate. - Monitored in diabetic patients on Metformin (an oral hypoglycaemic agent) as this medication can lower vitamin B12 levels.	- Educate patients on foods containing vitamin B12 to increase dietary intake. - Recommend patients take oral vitamin B12 supplements. - Supplement/adjust vitamin B12 in EN or PN. - Collaborate with physician re: need for vitamin B12 injections in patients with absorption issues. - Consider ordering Methylmelonic Acid (see below), where available.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	-Low levels may indicate depleted stores and/or absorption issues.	
Methylmelonic Acid (MMA) **(serum and urine)**	- Where this test is available, MMA is a better indicator of active vitamin B12 than serum vitamin B12. - Monitored to help identify early or mild vitamin B12 deficiency; test may be ordered as a follow-up to a vitamin B12 test result that is in the lower end of the normal range. - May be elevated in patients with inborn errors of metabolism involving B12 metabolism. - Low levels may indicate depleted stores and/or absorption issues. - Often ordered with homecysteine and folate due to interactions. - Urinary MMA is a non-invasive indicator of active vitamin B12 status that enables RD to determine if deficiency is related to dietary intake or malabsorption. - Provides a good index of vitamin B12 stores and distinguishes between folate and vitamin B12 deficiencies.	- Educate patients on foods containing vitamin B12 to increase dietary intake. - Recommend patients take oral vitamin B12 supplements. - Supplement/adjust vitamin B12 in EN or PN. - Collaborate with physician re: need for vitamin B12 injections in patients with absorption issues.
Vitamin C (Ascorbic Acid) [L019]	- Vitamin C is required for the growth and repair of all body tissues; an important protein used to make skin, scar tissue, tendons, ligaments, and blood vessels; also essential for the healing of wounds and for the repair and maintenance of cartilage, bones and teeth. - Deficiencies seen in smokers and patients on dialysis who have increased vitamin C needs due to losses during dialysis treatment; toxicities are rare.	- Educate patients on high vitamin C foods to increase dietary intake. - Recommend patients take oral vitamin C supplements. - Supplement/adjust vitamin C in EN or PN.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
25-Hydroxy Vitamin D [L606]	- Vitamin D required for absorption of calcium to maintain bone health and for prevention/monitoring of osteoporosis, reducing risk of bone fracture and adequate immune function. - Helpful to obtain baseline measurement; monitored to treat deficiencies, adequacy of dose and to prevent toxicities in patients on mega-doses (e.g., paediatric oncology and some patients that have undergone *bariatric surgery*). - Often monitored along with calcium and parathyroid hormone (PTH) due to interactions in body mechanisms to absorb calcium. - Deficiencies seen in obese population, long-term hospital stays, the elderly, liver disease, *inflammatory bowel disease*, *Cystic Fibrosis*, *Celiac disease*, oncology patients, post-operatively in bariatric surgery patients, pregnancy, athletes, vegetarians, vegans and those with food allergies/intolerances to milk and soy (both of which are fortified with vitamin D). - Renal bone disease is a common complication of chronic kidney disease and results in both skeletal complications (e.g., abnormality of bone turnover, mineralization, linear growth) and extra-skeletal complications (e.g., vascular or soft tissue calcification); patients with kidney disease often experience low vitamin D as conversion to the active form of vitamin D occurs in the kidneys; ability to do so may be impaired in this patient population.	- Educate patients on foods with high vitamin D to increase dietary intake. - Recommend patients take oral vitamin D supplements. - Supplement/adjust vitamin D in EN or PN. - For those at risk for osteoporosis, collaborate with physician re: need for bone-building medication regimen. - Monitor in combination with calcium and PTH levels.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
1,25-Dihydroxy Vitamin D [L588]	- This form of vitamin D reflects successful conversion (in the kidneys) from the inactive monohydroxy form of vitamin D to the active dihydroxy form. - In kidney disease, this conversion may be compromised; thus the lab level of 1,25 Vitamin D can help RDs identify issues with conversion of vitamin D to active form. - If there are bone issues (e.g., early-onset osteoporosis), 1,25 Vitamin D may be warranted to identify conversion issues. - 1,25 Vitamin D may also be recommended if liver enzymes are high, and/or if 25-hydroxyvitamin D is either very low or very high.	- RD would collaborate with physician regarding the need for *Calcitriol* medication which is often prescribed in patients with impaired active vitamin D conversion. - In patients on *Calcitriol*, RD would need to consider monitoring calcium and PTH in addition to 1,25 Vitamin D as this medication may cause calcium levels to increase which could lead to soft tissue calcification. - RD may also educate patients to modify intake or the timing of vitamin D and calcium-containing foods as *Calcitriol* may interfere with the absorption of these nutrients.
Vitamin E	- Vitamin E is an *antioxidant* that protects body tissue from damage caused by free radicals; important in the formation of red blood cells and it helps the body to use vitamin K; vitamin E is absorbed in small intestine. - Patients with pancreatic insufficiency, fat malabsorption, *Cystic Fibrosis*, *short bowel syndrome* and patients that have undergone bariatric surgery encounter changes in fat digestion and malabsorption of fat-soluble vitamins leading to deficiencies. - Monitored in lung transplants in those with *Cystic Fibrosis* as patients often experience elevated vitamin E levels post-surgery.	- Educate patients on foods containing high vitamin E to increase/decrease intake. - Recommend patients take oral vitamin E supplements. - Supplement/adjust vitamin E in EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
MINERALS		

Calcium
 	
(ionized, corrected and serum)
 	
[L046]
	- Serum calcium measures free-flowing calcium in the blood that is not attached to protein (as serum calcium is attached to the protein albumin); checked to determine the severity of abnormal serum calcium.
	- High levels may indicate *secondary hyperparathyroidism*, excessive vitamin D intake, decreased urinary calcium excretion (often seen in predialysis patients), metastatic bone tumours or multiple mylenoma.
	- Low levels seen in patients with low thyroid function, kidney failure and vitamin D deficiency.
	- Corrected calcium provides an assessment of serum calcium while taking into account calcium bound to albumin.
		- Educate patients on high calcium containing foods to increase/decrease dietary intake.
		- Recommend patients take calcium supplements along with vitamin D (as applicable).
		- Supplement/adjust calcium in EN or PN.
		- Collaborate with physician re: need for bone-building medication if supplementation is not improving levels.
		- In kidney disease patients:
		  - collaborate with physician re: abnormal calcium levels to modify calcium-based phosphate binders and/or vitamin D supplements.
		  - If calcium is high, collaborate with physician re: need for IV fluids and/or adjustments to diuretic medications.
		  - Collaborate with MD regarding other drug-nutrient interactions impacting with calcium levels.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Chromium	- Essential for normal carbohydrate and lipid metabolism. - Excreted in urine; those on PN who have renal failure may require chromium restriction. - Deficiency often seen in long-term PN patients; low levels can lead to impaired glucose tolerance and release of free fatty acids.	- Recommend oral chromium supplements to increase intake. - Supplement/adjust chromium in EN or PN.
Copper [L063]	- A trace mineral, part of several enzymes and proteins that are essential for adequate use of iron by the body. - Copper is mainly absorbed in first part of small intestine (duodenum), small amounts absorbed in stomach; excreted in bile. - Routinely monitored in patients on PN with abnormal liver function. - Deficiencies also seen in patients that have undergone *bariatric surgery*, patients with protein-energy malnutrition, burn patients, and those on dialysis. - Typically monitored with albumin as copper is transported to liver bound to albumin; low albumin may give false low serum copper result. - Interacts with zinc and iron; if checking copper consider iron status and zinc.	- Educate patients on foods containing high copper to increase/decrease dietary intake. - Recommend patients take oral copper supplement. - Supplement/adjust copper in EN or PN. - Monitor albumin and zinc levels. - Collaborate with physician re: need to correct albumin levels to normalize copper status.
Magnesium [L165]	- Required as a co-factor for many enzyme systems; involved in protein synthesis and energy generation, regulates potassium and calcium, and required for vitamin D metabolism. - Abnormalities often occur in patients that have undergone bariatric surgery, liver transplant patients, patients with *inflammatory bowel disease* and those with *high-output ostomies*. - Patients with long-term protein-calorie malnutrition or after long-term bowel rest (no food or water by mouth) can experience intracellular loss of magnesium during	- Educate patients regarding foods containing high magnesium to increase/decrease intake. - Recommend patients take magnesium oral mineral supplements. - Supplement/adjust magnesium in EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	refeeding; monitoring of magnesium allows for quick identification of *refeeding syndrome* and metabolic instability. - Deficiencies can cause disruptions in vitamin D metabolism and calcium levels. - Low levels of magnesium (along with potassium and phosphorus) can lead to respiratory and cardiac instability/muscle weakness. - Monitored in kidney disease patients to determine tolerance to magnesium-based phosphate binding medications. - Low magnesium may be associated with use of diuretic medications.	- Initiate oral feeding, EN and PN slowly and monitor magnesium to avoid *refeeding syndrome*. - Collaborate with physician regarding need for (or adjustments to) magnesium-based phosphate binders, diuretics and other medications that may impact magnesium absorption.
Phosphorus [L194]	- Involved in carbohydrate, protein and fat metabolism; essential for bone mineral metabolism and optimal bone health. - Influences parathyroid hormone and vitamin D levels which maintain calcium balance. - Patients with alcoholism, those who have undergone *bariatric surgery,* long-term bowel rest and protein-calorie malnutrition can experience intracellular loss of phosphorus during refeeding; monitoring of phosphorus allows for quick identification of *refeeding syndrome* and metabolic instability. - Patients dependent on ventilator for prolonged periods of time often experience low phosphorus levels. - Low levels of phosphorus (along with potassium and magnesium) can lead to respiratory and cardiac instability/muscle weakness. - Monitored in patients with kidney disease to manage phosphate-binding medications and modifications to vitamin D supplementation.	- Educate patients regarding foods containing high phosphorus to increase/decrease dietary intake. - Recommend patients take oral phosphorus mineral supplements. - Supplement/adjust phosphorus in EN and PN. - Initiate oral feeding, EN and PN slowly and monitor phosphorus to avoid *refeeding syndrome*. - Collaborate with physician regarding need for (or adjustments to) phosphate binding medications and vitamin D supplementation.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Serum Zinc [L266]	- Involved in numerous aspects of cellular metabolism; plays a role in immune function, protein synthesis, wound healing, DNA synthesis, and cell division; supports normal growth and development during pregnancy, childhood, and adolescence and is required for proper sense of taste and smell. - Low levels can lead to taste changes (often accompanied by metallic taste in mouth) and decreased appetite which may explain poor oral intake. - Deficiencies seen in patients that have undergone *bariatric surgery, inflammatory bowel disease* (Crohn's disease and Ulcerative Colitis), oncology and kidney disease patients, pancreatic insufficiency, alcoholic pancreatitis, HIV, *short bowel syndrome*, long-term PN, burn patients, alcoholism, anorexia, vegetarians and vegans, *failure to thrive*, genetic or metabolic disorders, muscle depletion the elderly as well as severe diarrhea and high output ostomies (e.g., *ileostomy*). - Elevated levels seen in cardiovascular disease and over-supplementation. - Interacts with copper; zinc and copper often checked together. - Typically monitored with albumin as zinc is transported in the body bound to albumin; low albumin may give false low zinc result.	- Educate patients on foods containing high zinc to increase/decrease dietary intake. - Recommend patients take oral zinc supplements. - Supplement/adjust zinc in EN or PN. - Monitor copper and albumin levels. - Collaborate with physician re: need to correct albumin levels to normalize zinc status.
RBC Zinc	- Second level of zinc status assessment to determine if zinc levels are abnormal in patients who present with zinc deficiency symptoms. - Low RBC Zinc would confirm zinc deficiency.	- Educate patients on foods containing high zinc to increase/decrease dietary intake. - Recommend patients take oral zinc supplements. - Supplement/adjust zinc in EN or PN. - Monitor copper and albumin levels.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
		- Collaborate with physician re: need to correct albumin levels to normalize zinc status.
Selenium	- Trace mineral involved in protein synthesis and plays a role as a cofactor for selenium-dependent enzymes; involved in wound healing; absorbed in small intestine. - Deficiencies seen in *gastric bypass surgery* patients, bowel resections where large portion of small intestine is bypassed, *high-output ostomies*, patients on long-term PN, persistent diarrhea and *inflammatory bowel disease*. - Selenium binds to albumin; low albumin may produce a falsely low serum selenium result; selenium often monitored along with albumin.	- Educate patients on foods containing high selenium to increase/decrease dietary intake. - Recommend patients take oral selenium supplements. - Supplement/adjust selenium in EN or PN. - Monitor albumin levels. - Collaborate with physician re: need to correct albumin levels to normalize selenium status.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Iron Panel: **Serum Iron** [L139] **Ferritin** [L329] **Total Iron Binding Capacity (TIBC)** [L329] **Transferrin Saturation** **Serum Transferrin** **Transferrin Receptor Index**	- Iron tests are typically ordered in combination to identify or rule-out issues with iron intake, circulating iron (serum iron), iron storage (ferritin) and iron binding capacity in the body (TIBC and transferrin saturation); monitored to prevent/treat iron deficiencies. - Iron absorbed mainly through small intestine; deficiencies seen in patients that have undergone *bariatric surgery*, *inflammatory bowel disease* (Crohn's disease, Ulcertive Colitis), *Cystic Fibrosis* and *Celiac disease*. - Deficiencies also common in patients with kidney disease, liver disease, congestive heart failure, menstruating women, eating disorders, infants/children consuming excess cow's milk, vegetarians, athletes, and the elderly who consume little red meat intake or foods containing iron. - Iron panel useful in pregnancy to identify early stages of iron deficiency through ferritin levels (stored iron) when other values (e.g. Hemoglobin) may be normal; iron monitored throughout pregnancy to ensure adequate level required for fetal development. - Elevated serum iron results may identify iron overload. - Serum transferring receptors increases with iron deficiency and is unaffected by chronic disease states; used as a sensitive and specific test for assessing iron status. - Iron may be checked along with vitamin B12 and folate due to interactions with this mineral.	- Educate patients regarding foods containing high iron to increase/decrease intake. - Recommend patients take iron supplements. - Supplement/adjust iron in EN or PN. - Collaborate with physician re: need for prescription medications to manage severe iron deficiency, medications to manage iron overload, or other medications impacting iron status. - Monitor vitamin B12 and folate as required.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
ELECTROLYTES		
Bicarbonate [L061]	- Used to monitor acid base balance in patients; often monitored with chloride and potassium. - High levels may indicate *alkalosis* and/or vomiting or purging in eating disorder patients; low levels may indicate high protein intake, *diabetic ketoacidosis*, and/or diarrhea.	- Collaborate with physician regarding best method to correct acid-base imbalance; consider need for sodium bicarbonate supplementation, need for added buffer (acetate) to PN solution and/or need for adjustment of chloride and potassium.
Chloride [L053]	- Required for energy metabolism and also helps maintain the body's acid-base balance; amount in blood is carefully controlled by kidneys. - Monitored to determine acid-base balance in patients, especially those on PN; often monitored along with bicarbonate and potassium. - Component of electrolyte testing for assessment of hydration status and kidney function insufficiencies. - High levels may indicate dehydration; low levels may indicate over-hydration, metabolic *alkalosis*, or losses from diarrhea and vomiting, or abuse of laxatives/diuretics in eating disorder patients.	- Educate patients on increasing/decreasing oral fluid intake and/or recommend electrolyte replacement beverage containing chloride. - Modify water flushes in patients on EN. - Adjust chloride in PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Potassium [L204]	- Essential for maintaining normal osmotic pressure in cells, maintaining normal cardiac and muscular function; acts as a co-factor for numerous enzymes, required for secretion of insulin, required for carbohydrate metabolism and protein synthesis; assists in maintaining acid-base balance. - Potassium and other electrolyte abnormalities may occur in athletes, eating disorders (due to purging or diuretic/laxative abuse) patients that have undergone bariatric surgery, patients on diuretic medications and those who experience persistent diarrhea or vomiting. - Patients with long-term protein-calorie malnutrition can experience intracellular loss of potassium during refeeding; monitoring of potassium allows for quick identification of *refeeding syndrome* and metabolic instability in those feed orally or through EN or PN. - Monitored with other electrolytes in patients with *high-output ileostomies*. - Abnormalities seen in kidney disease due to decreased potassium excretion in urine, intake of high potassium foods and medications that inhibit potassium excretion; low levels may be due to increased losses during dialysis. - Low levels of potassium (along with magnesium and phosphorus) can lead to respiratory and cardiac instability/arrhythmias and muscle weakness.	- Educate patients regarding foods containing high potassium to increase/decrease intake. - Recommend patients take oral potassium supplements. - Supplement/adjust potassium in EN or PN. - Initiate EN and PN feeds slowly and monitor potassium to avoid *refeeding syndrome*. - Collaborate with physician re: need for (or adjustment to) diuretics, potassium chelators and/or modification of dialysate bath in kidney disease patients undergoing dialysis. - Collaborate with physician re: need for intravenous potassium in patients with *high-output ostomies*.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Sodium [L226]	- Essential for regulating fluid balance in the body; often monitored with other markers of fluid/hydration status. - Elevated levels can indicate dehydration or excessive sodium intake; low levels can indicate fluid overload or sodium loss. - Disturbances seen post-operatively in patients that have undergone *bariatric surgery,* due to persistent diarrhea, vomiting and/or poor fluid intake. - Sodium depletion seen in patients with high stool and urine output as well as *high-output ostomies*, patients with edema (fluid retention), severe burns, starvation, water loading, diuretic and laxative abuse in eating disorder patients; sodium depletion (and other electrolyte imbalances) also seen in athletes due to sweat losses. - Most EN formulas contain low sodium and patients who are dependent solely on EN may develop low sodium levels. - Sodium monitored in kidney disease patients to determine target weights pre/post dialysis. - Monitored in conditions such as congestive heart failure and SIADH where fluid balance is a concern. - Often monitored with other electrolytes and minerals such as calcium and magnesium.	- Educate patients on increasing/decreasing oral fluids and/or sodium intake. - Adjust water flushes and/or sodium in EN. - Adjust sodium in PN. - Collaborate with physician re: fluids administered intravenously, diuretics and other medications affecting sodium/fluid balance.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
HEMATOLOGY		
Complete Blood Count (CBC) [L393] **Includes:** **While Blood Cell (WBC) Differential** [L372] **WBC Count** [L399] **Platelet Count** [L396] **Red Blood Cell Count (RBC)** [L397] **Red Blood Cell Width (RDW)** **Hematocrit (HCT)** [L417] **Hemoglobin (Hb)** [L418] **Mean Cell Hemoglobin Mean Corpuscular Volume (MCV)** **Mean Corpuscular Hemoglobin** (MCH)	- CBC typically monitored as an initial screening indicator of iron status, hydration and presence of infection. WBC Differential and WBC Count: - Indicates ability of patients to fight infection and possible presence of infection; high levels seen in acute infection, malignancy; low levels seen during chemotherapy and radiation. RBC: - Rarely high; low levels may indicate iron deficiency, blood loss or low vitamin B12 and folate levels. HCT: - Indicates the percentage of the volume of blood that is made up of RBCs; this measurement depends on the number and size of RBCs. - High levels may indicate dehydration, low levels may indicate iron deficiency, blood loss or over-hydration. Hb: - The protein molecule in RBCs that carries oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues to the lungs. - High levels may indicate dehydration, congestive heart failure, use of *erythropoietin* (to increase red blood cell production); low levels may indicate iron deficiency (especially to monitor changes to Hb during pregnancy), folic acid and/or vitamin B12 deficiency, chronic infection; low levels seen in athletes which may impact performance. MCV:	- If WBC low, RD may discuss strategies for food safety and prevention of food-borne illnesses (e.g., cooking times, avoiding cross-contamination, etc.). - If RBC, HCT or Hb low, may require further iron status lab tests: serum iron, ferritin, TIBC, transferrin saturation as well as assessment of vitamin B12 and folate status to confirm or rule-out deficiencies. - RD may initially educate patients on increasing iron-containing foods in diet. - Recommend oral iron supplementation and or supplement iron in EN or PN. - Collaborate with physician regarding patients on *Erythropoietin* (EPO) medication to determine adequate balance of iron supplements and EPO dosage.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Mean Corpuscular Hemoglobin Concentration (MCHC)	- Indicator of the size of RBC; low levels may indicate smaller RBCs from iron deficiency; high levels may indicate larger RBCs caused by folate and vitamin B12 deficiencies; folate and vitamin B12 should be tested to determine if cause of *anemia* is related in-part to these vitamin deficiencies; low levels seen in athletes which may impact performance. MCH & MCHC: - Calculation of size and average amount of hb inside RBC; indicates type of *anemia*.	
KIDNEY DISEASE		
Albumin [L005, qualitative] [L004, quantitative]	- Albumin is the main protein of plasma; it binds water, cations (such as calcium, sodium, and potassium), fatty acids, hormones, bilirubin and many medications; its main function is to regulate the osmotic pressure of blood. - About half of circulating blood calcium is bound to albumin; albumin is used to accurately assess calcium status. - Low albumin seen with low calcium levels; correcting calcium depletion helps correct low albumin levels. - May be an indicator of visceral protein status; low levels often seen in patients with multiple allergies, malabsorption, cancer, liver disease, end stage kidney failure, over-hydration or edema (fluid retention), inflammation and in those who are malnourished. - High levels seen in dehydration.	- If albumin levels are abnormal, RD would collaborate with MD to rule-out dehydration/over-hydration. - Educate client to increase/decrease fluid intake. - Increase/decrease water flushes in EN. - When calcium levels are low: educate client to increase dietary calcium intake, recommend patients take oral calcium supplements or add calcium to EN or PN.
Parathyroid Hormone (PTH)	- Indicates secondary hyperparathyroidism, efficacy of vitamin D analogue therapy in end-stage renal failure. - Helps interpret vitamin D and calcium levels for bone health.	- When vitamin D and calcium levels are low: educate client to increase dietary vitamin D and calcium intake, recommend patients take oral vitamin D calcium supplements or add vitamin D and calcium to EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Prealbumin	- Prealbumin has a half-life of 2-3 days and is a good marker of protein-energy malnutrition and response to nutritional therapies. - Low levels seen in liver disease, infection, and malnutrition. - Elevated levels seen in renal failure.	- Educate patients on increasing oral protein and calorie intake. - Adjust formula (type, rate, timing) if being fed through EN. - Adjust protein in PN solution.
Glomorular Filtration Rate (eGFR)	- Describes the flow rate of filtered fluid through the kidneys. - eGFR is calculated from the results of a creatinine test. - Used to screen for and detect early kidney damage (e.g., in diabetics) and to monitor kidney function in patients with chronic kidney disease.	- Modify diet education for increasing/decreasing protein, vitamin, mineral, electrolyte and/or fluid intake. - Depending on functional ability of kidneys, RD may change EN regimen/formula or adjust components of PN solution.
Dialysate Analysis for Glucose, Urea, Creatinine	- To determine protein catabolic rate, dialysate clearance, and glucose absorption.	- RD would modify nutrition care plan (oral, EN, or PN) to increase/decrease protein, carbohydrate and total calorie intake.
Blood Urea Nitrogen (BUN) [L251]	- BUN is formed when protein breaks down in the body; a measure of kidney function. - High levels may indicate dehydration from reduced fluid intake and/or vomiting and diarrhea as well as reduced kidney function or inadequate dialysis; high levels can lead to decreased appetite as urea builds up in blood. - Low levels may indicate a low-protein diet or malnutrition, fluid overload, SIADH or too frequent dialysis.	- Educate patients on increasing/decreasing fluid intake. - Educate patients on increasing/decreasing protein intake. - Adjust type of EN formula (e.g., higher/lower protein product and increase/decrease water flushes).

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Abnormalities often seen in chronic kidney disease and patients undergoing chemotherapy.	- Increase/decrease protein in PN. - In oncology patients, RD would collaborate with physician and pharmacist to determine if chemotherapy may be causing kidney damage or whether dehydration was a concern.
Serum Creatinine [L067]	- Creatinine is a breakdown product of creatine, which is an important part of muscle; marker of lean body mass/skeletal protein levels. - Creatinine is a marker of kidney function; creatinine is removed from the body by kidneys and excreted in the urine. - Used to monitor patients with diabetes and chronic kidney disease; monitored along with BUN and urinary creatinine clearance. - High levels may indicate reduced kidney function, insufficient dialysis, and/or dehydration from lack of fluid intake and/or vomiting/diarrhea. - Low levels seen in liver disease and pregnancy signalling lean body mass loss which may warrant an increase in protein and calorie intake.	- Educate patients to increase/decrease fluid and protein intake. - Reduced renal function may also require decreased potassium, phosphorus, and magnesium intake. - Adjust fluid protein, electrolyte, vitamins and minerals (required) in EN or PN. - Collaborate with physician re: dialysate to improve clearance during dialysis. - In oncology patients, collaborate with physician and pharmacist to determine if chemotherapy or other medications may be causing kidney damage requiring dietary modifications or whether dehydration is a concern.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Urinary Creatinine Clearance [L068]	- Creatinine is a breakdown product of creatine, which is an important part of muscle; marker of lean body mass/skeletal protein levels; creatinine is removed from the body by kidneys and excreted in urine; marker of kidney function. - Often monitoring along with BUN and serum creatinine.	- Educate patients to increase/decrease fluid/protein intake. - Reduced renal function may also require decreased potassium, phosphorus, and magnesium intake. - Adjust fluid protein, electrolyte, vitamins and minerals (as required) in EN or PN. - Collaborate with physician re: dialysate to improve clearance during dialysis. - In oncology patients, collaborate with physician and pharmacist to determine if chemotherapy or other medications may be causing kidney damage requiring dietary modifications or whether dehydration is a concern.
Serum Osmolality [L183]	- Measures the number of solutes present in the blood to help evaluate the body's water balance, its ability to produce and concentrate urine, and to help investigate fluid status, low sodium levels and presence of SIADH. - Elevated osmolality seen in patients with high sodium levels and dehydration. - Often monitored with sodium.	- Educate patients on increasing/decreasing fluid and sodium intake. - Adjust EN and PN regimens to increase/decrease fluid intake. - Collaborate with physician regarding the need for (or modifications to) diuretics.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Albumin/Creatinine Ratio, Urine	- Estimates 24-hour urine albumin excretion/spilling of albumin in urine and is unaffected by variation in urine concentration. - Preferred measure for screening, assessing and monitoring early kidney damage. - Often measured along with eGFR to determine stage of kidney function that may impact nutrition care plan. - Indicates compliance in protein, carbohydrate and fluid intake as well as balance of carbohydrate-protein intake.	- Helps RD to direct patient education to identify a need for modifications to protein, fluid and/or carbohydrate intake. - Adjust protein, fluid and/or carbohydrate intake in EN or PN.
Uric Acid (Urate) [L252]	- Final breakdown product of purine (organic compounds found in food) metabolism in the body and is excreted in urine. - Monitored in patients with glycogen storage disorders who required purine and carbohydrate modified diets. - Also monitored in patients with gout to determine need for dietary modifications to prevent gout flare-up or uric acid stones as well as compliance with gout medication. - High levels may indicate disordered purine metabolism associated with excessive production and impaired excretion of uric acid; low levels may indicate possible malnutrition or excessive gout medication (e.g. Allopurinol). -	- Educate patients on decreasing consumption of high-purine foods and alcohol as well as increasing fluid intake to increase urine volume output. - Collaborate with physician re: modifications to gout medications and or need for further investigation of possible disordered purine metabolism.
24-Hour Urinalysis for Urea Nitrogen (UUN)	- A measure of protein breakdown in the body; quantifies amount of protein breakdown to help determine patients' protein needs. - Measured in patients with chronic kidney disease. - Inadequate protein delivery or accumulated protein deficit has negative effects on critically ill patients (e.g., immune dysfunction, risk for infection, poor wound healing, weight loss, decreased functional capacity, and prolonged hospital stay).	- Educate patients to increase/decrease oral protein intake. - Adjust protein in EN and PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
24-Hour Urinalysis for Total Volume	- Assesses kidney's ability to excrete fluids. - Monitored in patients with kidney disease and to determine fluid needs and assess compliance with fluid intake recommendations.	- Educate patients to increase/decrease oral protein intake. - Adjust protein in EN and PN - Collaborate with physician re: need for (or adjustment to) diuretics and other medications influencing fluid/hydration status.
24-Hour Urinalysis for Sodium	- Useful in the assessment of low-salt dietary compliance in the management of *ascites*, which can lead to decreased appetite. - *Ascites* is typically caused by liver disease and is common in patients waiting for a liver transplant who often require frequent *paracentesis*. - Also used to assess excessive sodium intake in patients at risk for kidney stones; excessive sodium intake can increase calcium excretion; monitored along with urinary calcium.	- Educate patients to decrease oral sodium intake. - Adjust sodium intake in EN or PN. - Collaborate with physician re: diuretics or other medications impacting hydration status. - In patients with risk of kidney stones, educate to increase fluid intake; if calcium low, educate to increase oral intake or recommend supplements.
Urinalysis for Protein [L253]	- Measures spilling of protein in urine due to inadequate kidney function. - Indicator of compliance with protein restriction recommendations.	- Educate patients to decrease protein intake to reduce spilling of protein in urine. - Adjust sodium intake in EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Parathyroid Hormone (PTH) [L330]	- Regulates calcium, phosphorus and vitamin D levels in the body - PTH release is controlled by level of calcium in body; PTH increases in attempt to increase calcium levels - Inadequate calcium and vitamin D can cause *secondary hyperparathyroidism*. - Correcting calcium level may normalize PTH. - Monitored in *gastric bypass* surgery patients, other patients with gastrointestinal malabsorption as well as chronic kidney disease.	- Educate patients to increase intake of calcium and vitamin D containing foods. - Recommend patients take calcium and vitamin D supplements. - Add calcium and vitamin D to EN or adjust in PN. - Collaborate with physician regarding high-dose vitamin D supplementation, calcium-binding medications and/or phosphate-binding medications.
LIVER DISEASE		
Liver Function Panel **Includes:** **Aspartate Aminotransferase (AST)** **Alanine Aminotransferase (ALT)** **Alkaline Phosphatase (ALP)** [L191] **Bilirubin** [L030] Lactate Dehydrogenase (LDH) (where offered)	- Monitored when patients have liver injury or are at risk for developing liver disease (e.g., liver function abnormalities seen in long-term PN, chemotherapy, NAFLD, bone marrow transplants, genetic metabolic diseases, trauma, burns). - Also used to monitor liver function in patients who are on statin medications to lower cholesterol levels; statins can impact liver function and may require modifications to calorie/fat/protein intake. - AST, ALT and bilirubin are monitored in long-term PN patients to determine tolerance to nutrient intake and to assess levels to indicate cholestasis (when bile cannot flow from the liver to the duodenum). - ALP is a zinc-dependent enzyme; may be an indirect indicator of zinc status when AST and ALT are normal; a low ALP along with a low zinc level may confirm zinc deficiency to help correct taste and appetite abnormalities. - ALT & AST indicate the liver's tolerance for fat-soluble vitamins.	- Educate patients on low-liver burden diet including modifications to calorie, fat, protein and carbohydrate intake. - Adjust EN or PN to lower protein, fat, sodium and fluids. - Collaborate with physician re: changing feeding regimen from PN to EN in patients who are not tolerating PN. - Adjust PN (e.g., remove manganese, copper). - Confirmation of zinc deficiency may require education to increase zinc-

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Tests can be ordered individually or as part of a liver function panel.	- LDH is an enzyme that catalyzes the conversion of lactate to pyruvate; an important step in energy production in cells.	containing foods, oral supplements, or additions to EN or PN solution. - Collaborate with physician re: drug-nutrient interactions impacting liver function.
Ammonia [L015]	- A metabolic by product of amino acid breakdown. - Monitored to determine tolerance to protein intake in patients with liver failure. - Patients with liver disease and certain inborn errors of metabolism often have altered ammonia metabolism; elevated levels can have negative effects on the brain.	- Educate patients to decrease quantity and/or type of protein intake. - Consider need for branched-chain amino acid therapy in EN and/or lower protein content of EN or PN.
Lactate (Lactic Acid) [L145]	- Marker of lactate production formed when the body breaks down carbohydrates to use for energy during times of low oxygen levels. - Lactate builds up when patients are not being provided adequate nutrition (e.g., insufficient glucose/sugar) and therefore glucose/sugar is not able to be metabolized or broken down to provide carbon dioxide and water required for energy production in the body. - Lactate can also be a marker of blood flow/oxygen supplied to gastrointestinal tract; assists in assessing adequate gastrointestinal tract function to safely start EN or to start/continue PN. - Often elevated in respiratory disorders, liver disease, glycogen storage diseases treated with carbohydrate modified diets and patients with organic acidemias which are treated with modified protein diets.	- Educate patient to adjust amount dietary calorie/protein/carbohydrate intake. - Adjust calorie/protein/carbohydrate content of EN or TPN. - Collaborate with physician re: patient's ability to tolerate EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- RD would use lactate (in addition to other biochemistry) to adjust the amount of protein, carbohydrate or energy/calories being provided in the diet to assist with the reduction of lactate levels.	
24-Hour Urinary Lactate to Creatinine Ratio	- Used as a marker of lactate production in disease states characterized by increased lactate levels (e.g., glycogen storage diseases who receive specific quantities of carbohydrate at multiple times during a 24-hour period). - Identifies specific changes to lactate levels across the 24-hour period to modify the amount of carbohydrate provided orally or through EN or PN to suppress lactate production. - Lactate alone would not allow RD to pinpoint variation of lactate levels throughout the day limiting the ability to make time-specific adjustments to carbohydrate intake.	- Educate patient to adjust amount or timing of dietary carbohydrate intake. - Adjust amount or timing of carbohydrate content of EN or TPN.
PANCREATIC DISEASE		
Amylase [L018]	- An enzyme involved in carbohydrate digestion. It is produced mainly in the pancreas and the glands that make saliva. When the pancreas is diseased or inflamed, amylase is releases into the blood and thereby a marker of pancreatic function. - Elevated amylase levels may indicate need for tube feed placement past stomach into small intestine and/or elemental EN formula. - When initiating EN, increased amylase may indicate undesirable pancreatic stimulation or intolerance to EN. - Elevated levels of amylase seen in eating disorder patients experiencing vomiting or excessive gum chewing. - Often ordered in combination with lipase.	- Educate patients to limit carbohydrate intake if levels indicate reduced pancreatic function. - Use specialized elemental EN formulations. - Reduce carbohydrate in PN solution - Collaborate with physician re: optimal placement of tube for EN. - Monitor lipase.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Lipase [L150]	- A protein released by the pancreas into the small intestines; triggers the breakdown of fat into fatty acids and is a marker of pancreatic function. - Elevated lipase levels may indicate, pancreatitis, excess fat intake in patients on a *ketogenic diet,* and/or the need for tube feed placement past the stomach into the small intestine and/or an elemental EN formula. - When initiating EN, increased lipase may indicate undesirable pancreatic stimulation or intolerance to EN. - Often ordered in combination with amylase.	- Educate patients to limit fat intake if levels indicate reduced pancreatic function. - Use specialized elemental EN formulations and those lower in fat. - Reduce lipids in PN solution. - Collaborate with physician re: optimal placement of tube for EN. - Educate eating disorder patients on strategies to increase dietary food intake and decrease gum chewing; adapt nutrition care plan to include regular meals/snacks to decrease susceptibility to binging/purging. - Monitor amylase.
DIABETES		
Random Blood Glucose [L111]	- Provides a measure of circulating blood glucose levels at a random point in time to determine the body's ability for maintaining blood sugar control. - Used for monitoring of diabetic patients who are unable to have a fasting blood glucose test or those who are not self-monitoring with glucose meter and/or those patients who haven't been seen regularly by RD and "drop in." - Monitored post-operatively in patients that have undergone *bariatric surgery*, to determine improvements in blood glucose levels (many diabetic patients see improvements in blood glucose levels following *bariatric surgery*). - Monitored to avoid high blood glucose levels when refeeding patients after prolonged bowel rest.	- Educate patients on dietary changes to carbohydrate intake to achieve glucose control for both high and low blood sugar levels. - Adjust EN formula, rate, and/or timing. - Adjust carbohydrate intake in PN. - Collaborate with physician re: adjustments to insulin/oral hypoglycaemic agents.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Physiological stress of cancer can alter blood glucose levels (even in those who are not diabetic); monitored in oncology patients to ensure normal blood glucose levels. - Can be an initial indicator that client is at risk of gestational diabetes or impaired glucose tolerance in pregnancy. - May be used as a yearly calibration tool to compare random blood glucose with patient's glucose meter results.	- Adjust insulin/oral hypoglycaemic agents where medical directive exists and communicate changes to physician and rest of health care team. - Collaborate with physician re: need for Oral Glucose Tolerance Test to confirm/rule-out diabetes.
Fasting Blood Glucose [code]	- Provides a measure of circulating blood glucose levels in a fasting state to determine the body's ability for maintaining blood sugar control and identify impaired fasting blood glucose. - Helpful in patients who are not self-monitoring blood glucose levels with glucose meter to identify fasting glucose patterns that may require modifications to nutrition and pharmacological care. - Used when Hgb A1c does not correlate to their glucose self-monitoring through glucose meter checks. - Patients with *inflammatory bowel disease*, pancreatitis, severe infection, chronic liver disease, inborn errors of metabolism and those on prednisone often experience abnormal fasting blood glucose levels or steroid-induced diabetes. - May be used as a yearly calibration tool to compare fasting blood glucose with patient's glucose meter results.	- Educate patients on dietary changes to carbohydrate intake to achieve glucose control for both high and low blood sugar levels. - Adjust EN formula, rate, and/or timing. - Adjust carbohydrate in PN. - Collaborate with physician re: recommendations for adjustments to insulin/oral hypoglycaemic agents as required. - Where a delegation exists for RDs to adjust insulin/oral hypoglycaemic agents, adjust levels accordingly and

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Used to monitor blood glucose control in non-diabetic eating disorder patients to assess glycogen stores and determine compliance to dietary intake, as low levels may indicate minimal oral intake.	- communicate changes to physician and rest of health care team. - Collaborate with physician re: need for Oral Glucose Tolerance Test to confirm/rule-out diabetes. - Recommend new glucose meter where fasting blood glucose results show discrepancies with meter. - Educate eating disorder patients on strategies to increase dietary food intake.
Fructosamine	- Fructosamine concentration reflects glucose status over the previous three weeks in contrast to HbA1c which reflects glucose status over the past 3 months. - Can be measured in pregnancy where timely intervention is warranted.	- Educate client on glycemic control diet. - Collaborate with physician re: need for insulin/insulin adjustment.
Oral Glucose Tolerance Test [Standard test: L104 blood and L253,urine] [Gestational test, L103]	- Determines the body's ability to handle a glucose load. - Identifies impaired glucose intolerance (IGT) and impaired fasting glucose (IFG), both of which are risk factors for developing diabetes. - Used by physicians to diagnose diabetes. - IGT/IFG can be seen in many conditions including overweight patients, those with family history of diabetes, polycystic ovarian syndrome, those with history of gestational diabetes, and patients with *Cystic Fibrosis*. In Pregnancy: - All pregnant women between 24-28 weeks are screened for gestational diabetes (GDM) through 50 g glucose load. - If results show IGT, further testing with a larger glucose load (75 g) may be warranted to confirm IGT or GDM.	- In patients with IGT, IFG: educate on dietary changes to achieve weight loss and/or modifications to carbohydrate intake to achieve blood glucose control to prevent diabetes. - <u>In physician-confirmed cases of diabetes:</u> - Educate patients on dietary changes to carbohydrate intake to achieve glucose control. - Collaborate with physician re: recommendations for adjustments to

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Timing is critical: If patients are screened too early, GDM may be missed as hormones released during pregnancy that cause insulin resistance are lower prior to 24 weeks gestation; if screened too late may lead to pregnancy complications to both mother and fetus. - To ensure minimal risk to baby, RD authority to order this test would be efficient patient-centred care; RD would refer patient to physician to confirm formal GDM diagnosis and have physician prescribe pharmacological treatment. - In obese gestational clients test is repeated in 3rd trimester if normal at 24-28 weeks; rules out GDM later in pregnancy.	insulin/oral hypoglycaemic agents as required. - Where a delegation exists for RDs to adjust insulin/oral hypoglycaemic agents, adjust levels accordingly and communicate changes to physician and rest of health care team.
Hemoglobin A1c (HbA1c) [L093]	- Presents an average blood sugar level of previous 3 months. - Monitored in patients with diabetes to determine effectiveness of nutrition care plan and pharmacological regimen for achieving blood glucose control; elevated levels may indicate non-compliance with dietary/pharmacological management warranting modifications care plan. - Persistent elevated HbA1c levels can lead to diabetic complications (e.g. eye and foot complications, cardiovascular disease, impaired kidney function). - Monitored post-operatively in patients that have undergone *bariatric surgery*, and liver/lung/kidney/pancreas transplant patients to determine improvements in blood sugar control (many diabetic patients see improvements in blood sugar control following *bariatric surgery*, or transplants). - Cancer patients with pre-existing diabetes can experience changes in blood sugar levels during disease progression and/or treatment; physiological stress of cancer and chemotherapy can alter blood sugar control (even in those who are not diabetic); monitored in oncology patients to avoid/correct high blood sugar levels.	- Educate patients on dietary changes to carbohydrate intake to achieve glucose control. - Adjust timing/rate of carbohydrate intake in EN or PN. - Collaborate with physician re: adjustments insulin/oral hypoglycaemic agents. - Where a delegation exists for RDs to adjust insulin/oral hypoglycaemic agents, adjust levels accordingly and communicate changes to physician and rest of health care team.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Elevated HbA1c levels seen in eating disorder patients and athletes who are misusing insulin as a weight-control measure (insufficient insulin administration in type 1 diabetics can prevent weight gain).	
Ketones (Urinary and Serum)	- *Ketones* are formed when the body breaks down fatty acids for energy leading to a build-up of *ketones* which can have toxic effects on the body. - Measures whether fatty acids are being broken down for energy in patients with diabetes and in patients with eating disorder to determine compliance with dietary intake. - Monitored in patients with inborn errors of metabolism and those on a ketogenic diet. - Also monitored in high-performance athletes to determine if dietary intake is sufficient to meet energy needs, and/or if patients are ingesting adequate carbohydrate intake or over-training.	- Educate patients on strategies to increase carbohydrate and total calorie intake to meet dietary needs in diabetics and eating disorder patients. - Adjust timing/rate of carbohydrate intake in EN or PN. - In athletes, develop strategies to increase carbohydrate and total energy intake to ensure performance isn't compromised by insufficient energy intake.
CARDIOVASCULAR DISEASE		
Lipid Panel: **Triglycerides** [L243] **Low Density Lipoprotein (LDL)** **High Density Lipoprotein (HDL)** [L117]	- Lower LDL, triglycerides, total cholesterol, lower cholesterol to HDL ratio and higher HDL levels are correlated with reduced risk of cardiovascular disease. Lipid panel tests are monitored to: - Identify risk, presence, or severity of cardiovascular disease; early detection of cardiovascular disease risk may warrant preventative dietary and lifestyle modifications. - Determine if current dietary interventions are assisting with improved lipid profile target ranges.	- Lipid panel results will determine level of patient education required: aggressive versus moderate dietary restrictions to normalize lipid levels. - Educate patients to decrease total fat, saturated and trans fat, simple sugars and alcohol intake and increase omega-3 fat and fibre intake.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Total Cholesterol [L055] **Total Cholesterol to HDL Ratio** Non-HDL **Ordered as a panel, tests can be ordered separately as needed.**	- To determine if patients with cardiovascular disease, diabetes, and those who are overweight or obese require aggressive lipid dietary management to normalize levels. - Reduce risk of developing cardiovascular disease in chronic kidney disease patients; cardiovascular disease risk increases as kidney function/filtration rate decreases. - Assess lipid levels in patients with pancreatitis, liver disease, NAFLT, NASH, lung/liver/kidney transplants, alcoholism, pancreatitis, and those with spinal cord injury as these patients often experience elevated lipid panel results. - Determine tolerance to fat in patients on a high fat diet (e.g., *ketogenic diet* and patients with *Cystic Fibrosis*). In PN patients triglycerides are closely monitored to: - Detect clearance of triglycerides in circulation within the body to reduce risk of pancreatitis induced by high triglyceride levels resulting from poor triglyceride (lipid) clearance. - Identify and prevent fat overload syndrome which can have negative effects on respiratory, vascular and immune systems.	- Educate patients on calorie reduced diet to induce weight loss; weight loss often results in improvements in lipid panel levels. - Adjust EN or PN regimen to reduce calories/ fat/carbohydrate intake and/or induce weight loss. - Collaborate with physician re: need for pharmacological intervention (lipid lowering medication) in patients whose dietary, EN or PN modifications are not demonstrating improvements in lipid panel results.
Homocysteine	- An amino acid; high circulating blood levels may indicate increased risk of coronary heart disease, stroke and peripheral vascular disease. - Levels can be influenced by diet; folate, vitamin B6 and vitamin B12 all help break down homocysteine in the body which may result in a lower risk of cardiovascular disease.	- Educate patients on heart healthy diet and to increase folate, vitamin B6 and/or vitamin B12 containing foods, and/or recommend patients take oral vitamin supplements.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Monitored to determine if a person has vitamin B12 or folate deficiency as homocysteine concentration may be elevated before vitamin B12 and folate tests are abnormal. - Also monitored in patients with high cardiovascular disease risk and those with inborn errors of metabolism involving vitamin B12.	- Adjust folate, vitamin B6 and/or vitamin B12 to EN or PN. - Collaborate with MD re: need for vitamin B12 injections in suspected cases of malabsorption.
EATING DISORDERS		
Urine Specific Gravity	- A measure of hydration status. - Often measured in eating orders to determine if patient is water loading prior to weighing; helps assess compliance with food intake. - Monitored in high-performance athletes and spinal cord injury athletes who have impaired thermoregulatory responses to ensure adequate fluid intake and hydration status.	- Educate patients re: decreasing fluid intake. - Educate patients on strategies to increase carbohydrate and total calorie intake to meet dietary needs in eating disorder patients.
Anion Gap	- Used to determine metabolic acidosis; calculated by subtracting the serum concentrations of chloride and bicarbonate from the concentrations of sodium plus potassium.	- Metabolic acidosis caused by starvation: educate patients on strategies to increase dietary intake.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- High levels may indicate starvation with ketone production and/or lack of compliance to dietary intake in eating disorder patients; may also be high due to low magnesium and calcium levels.	- Adjust calorie/carbohydrate intake in EN or PN. - Metabolic acidosis caused by deficiencies of magnesium and calcium: Educate patients to increase oral calcium and magnesium intake, recommend patients take oral calcium and magnesium supplements, add calcium and magnesium to EN or adjust in PN.
FOOD INTOLERANCES		
Anti-Tissue Transglutaminase (tTG-IgA and IgA and IgG separately)	- Gluten intolerance screen; determines the body's ability to digest gluten-containing foods; positive test may indicate need for gluten restriction in diet. - *Celiac disease* can only be confirmed through a small bowel biopsy. - If physician confirms *Celiac disease* diagnosis, tTG-IGA can be used to monitor compliance to a gluten free diet, especially in patients experiencing gastrointestinal symptoms. - Gluten ingestion in *Celiac disease* patients can increase risk of osteoporosis, lymphoma, and *anemia*.	- Positive test would warrant referral of patients to physician to confirm *Celiac disease* diagnosis through small bowel biopsy. - In patients with a positive test wish to eliminate gluten in diet rather than confirm *Celiac disease* diagnosis through biopsy: RD would educate patients to avoid gluten in diet. - In physician confirmed cases of Celiac disease, RD would educate patients to avoid gluten in diet.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
		- Periodic tTG-IgA testing helps identify hidden sources of gluten in diet to help RDs enhance education and strategies for patients to become more compliant with gluten-free diet.
Hydrogen Breath Test for Lactose Intolerance	- To confirm/rule-out lactose intolerance and need for lactose restriction in diet. - Lactose intolerance can lead to gas, bloating, diarrhea when lactose containing foods are ingested. - Lactose intolerance can increase risk of developing osteoporosis due to reduced intake of dairy foods and beverages that are high in calcium and vitamin D. - Can also cause patients to avoid many foods and try to self-manage symptoms leading to unbalanced diet and unnecessary food avoidance and fear of foods in eating disorder patients.	- Positive test would warrant need for lactose-restricted diet or lactose-free EN formula. - Educate patients to avoid lactose-containing foods and/or use lactase enzyme supplements. - Education ensures the patient's diet is rich in non-dairy or lactose free sources of calcium and vitamin D. - Recommend patients take oral calcium and vitamin D supplements if indicated.
Hydrogen Breath Test for Fructose Intolerance	- To confirm/rule-out fructose intolerance and need for fructose restriction in diet. - Fructose intolerance can lead to gas, bloating and diarrhea. - Can also cause patients to avoid many foods and try to self-manage symptoms leading to unbalanced diet and unnecessary food avoidance and fear of foods.	- Positive test would warrant need for fructose-restricted diet. - Educate patients on avoiding fructose-containing foods and guidance on balanced diet and/or oral supplement intake to prevent vitamin and mineral deficiencies.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Carnitine (free and total)	- Carnitine is a compound made in the body from the amino acids lysine and methionine; required for the transport of long-chain fatty acids into mitochondria and plays a critical role in cellular energy metabolism. - Patients with mitochondrial disorders of fatty acid transport and patients on long-term PN with chronic malnutrition can experience carnitine deficiency which can lead to abnormalities in energy production and lipid tolerance. - Carnitine can also be depleted secondary to medication use (e.g., anti-seizure medication) or as a function of a specific disease (e.g., common in patients with organic acidemias) where carnitine becomes attached with toxic compounds (specific to each disorder) and is excreted in the urine, thereby depleting the overall carnitine levels. - Assessing both total and free carnitine and the ratio between them in the context of long-term malnutrition or ongoing lipid intolerance allows RD to decide whether patients require carnitine supplementation (orally or in EN or PN). - RDs can use total carnitine lab values in part to determine if the diet is adequate in protein and if the patient is utilizing fat for energy adequately.	- Educate patients on foods containing high protein and carnitine content to increase dietary intake. - Educate patients to increase/decrease dietary fat intake. - Adjust protein and fat accordingly in EN or PN. - Collaborate with physician re: need for (or adjustment to) oral carnitine prescription medication or additions to EN or PN.
Acylcarnitine	- Acylcarnitines are a marker of the adequacy of nutritional care in patients with inborn errors of metabolism. - In patients with organic acidemias, acylcarnitines are a marker of organic acid production (from amino acids), as the acids are scavenged and bound to carnitine and therefore measureable through acylcarnitines. - In fatty acid oxidation defects (where long chain fatty acids are restricted in the diet), acylcarnitines are a marker of fatty acids that cannot be utilized by the body (suggesting that intakes of long chain fatty acids exceed needs).	- Results may indicate presence of protein and fatty acid metabolism disorders warranting RD to modify protein and fat intake in oral diet, EN or PN.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- If RDs only ordered carnitine on patients with organic acidemia and found the level to be depleted, they could assume carnitine deficiency; by also checking acylcarnitine levels (routine monitoring in certain metabolic conditions such as organic acidemia and fatty acid oxidation defects), the dietitian would be able to assess if the diet (either the amount of fat or protein being provided) is adequate or excessive.	
Plasma Fatty Acids	- Important for the formation of healthy cell membranes, proper development and functioning of the brain and nervous system and the production of hormones. - Certain fatty acids are essential, as they cannot be made by the body, and must be obtained from dietary sources; patients on tightly restricted low fat diets (e.g., fatty acid oxidation defects) are at high risk of essential fatty acid deficiency.	- Educate patients on increasing/decreasing fat intake or modifying type of fat intake (e.g., short/long/medium-chain triglycerides). - Adjust fat in EN or PN.
Fecal Fat	- Monitored to assess fat malabsorption. - Fat malabsorption can lead to weight loss and decreased absorption of fat soluble vitamins.	- Educate patients on reducing fat intake or for increasing intake of modified fat foods (e.g., those containing medium-chain triglycerides). - Adjust fat in EN or PN. - Recommend patients take multivitamin supplement to prevent fat-soluble vitamin deficiencies or add multivitamin to EN or adjust components of PN. - Collaborate with physician re: need for (or adjustment to) pancreatic enzymes.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Fecal Elastase 1	- Used to assess pancreatic function in patients with *Cystic Fibrosis* and chronic pancreatitis. - Knowing if patients are pancreatic insufficient will determine whether patients require pancreatic enzymes. - Identifies patients who require high energy/high fat dietary education.	- Educate patients on consuming high fat/high calorie diet. - Consider high fat/high calorie EN formula. - Increase calorie and fat in PN.
Reducing Substances (Fecal)	- Monitored to assess carbohydrate malabsorption.	- Educate patients on limiting/restricting carbohydrate containing foods in diet. - Modify EN formula or adjust carbohydrate in PN solution to limit/restrict carbohydrate intake.
Urinary Organic Acids	- Provides a metabolic "snapshot" based on the products the body discards through the urine; indicates by-products of human cellular activity, the digestion of foods, and the metabolism of gastrointestinal flora. - At certain levels, organic acids in urine may be indicators of toxicity or "markers" of metabolic pathways. Metabolites of yeast or gastrointestinal bacteria appear against the background of normal human metabolites and provide an assessment of yeast and bacterial activity in the body.	- Educate patients on limiting/restricting protein containing foods in diet. - Modify EN formula or adjust protein in PN solution to limit/restrict intake.
Quantitative Amino Acids	- Measures circulating amino acids (building blocks of protein) in blood. - Used in patients requiring an amino acid restricted diet (e.g., PKU) to monitor intake of amino acids to determine sufficient protein intake and to verify compliance with restricted dietary intake.	- Educate patients on appropriate dietary intake of protein and restrictions to amino acid intake (as applicable).

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Also a marker of excessive intake of amino acids in the diet which the body is unable to utilize; can contribute to production/build-up of toxic substances (e.g., lactate, organic acids and ammonia).	- Adjust protein EN or PN solution to meet metabolic needs.
Urinary Amino Acids	- A measure of the amount of amino acids in the urine which may indicate presence of inborn errors or issues with protein metabolism. - Provides a marker of the body's utilization of amino acids.	- Educate patients on limiting/restricting protein containing foods in diet. - Modify EN formula or adjust protein in PN solution to limit/restrict intake.
MISCELLANEOUS		
Plasma Citrulline Level	- Monitors functional status of gastrointestinal tract; marker of intestinal absorptive function. - Aids in determining when patients may be ready for transition from PN to EN in *short bowel syndrome* and/or prognostic indicator of long-term PN dependency in this patient population.	- Collaborate with physician re: determination of most appropriate route of nutrition support (e.g., transition to EN or continue on PN). - Adjust EN formulation and PN solution as required.
Interleukin 6 (IL-6)	- Secreted by the body to stimulate immune response to trauma, especially burns or other tissue damage leading to inflammation.	

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
	- Inflammation from acute physical activity can also stimulate IL-6 production which can act in both a pro-inflammatory and anti-inflammatory manner. - IL-6 induces production of hepcidin, an iron-regulatory hormone that when produced may lower iron absorption.	- Helps RD identify iron deficiency caused by trauma/inflammation versus intake or absorption issues. - If inflammation ruled out, RD may recommend dietary intervention (refer to iron panel management above). - Collaborate with physician re: need for medical intervention to alleviate inflammation or underlying medical condition prior to nutrition intervention to correct iron abnormalities.
Hepcidin	- A peptide hormone that is released in chronic disease and exercise; a key regulator of iron homeostasis that may reduce iron absorption in the body which may explain high prevalence of iron deficiency in female athletes. - Measurement of hepcidin would help differentiate between iron deficiency *anemia* of infection/inflammation versus that of a true iron deficiency.	- Helps RD identify iron deficiency caused by trauma/inflammation versus intake or absorption issues. - If inflammation is ruled out, RD may recommend iron dietary intervention (refer to iron panel management above). - Collaborate with physician re: need for medical intervention to alleviate inflammation or underlying medical condition prior to nutrition intervention to correct iron abnormalities.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

LAB TEST [CODE]	RATIONALE FOR NUTRITION ASSESSMENT & MONITORING	HOW NUTRITION CARE PLAN WOULD BE MODIFIED BY LAB TEST RESULTS
Blood Gases	- Used to evaluate oxygenation and acid/base balance. - Often ordered along with other tests such as electrolytes to determine if an electrolyte imbalance is present, glucose to evaluate blood sugar concentrations, and BUN and creatinine to evaluate kidney function. - Identifies metabolic acidosis secondary to diet restriction/malnutrition or *ketogentic diet.*	- Adjust amount of carbohydrate, fat and fluid in patients on EN and PN to normalize acid-base balance.
Beta-hydroxybutyrate	- Beta-hydroxybutyrate is a ketone body produced when there is inadequate circulating glucose and fatty acids are broken down for energy. - Children with epilepsy may be put on a *ketogenic diet* to control seizures.	- Indicates level of ketone production to determine if dietary glucose restriction is sufficient to help manage seizures. - Collaborate with physician re: dietary management and interactions with seizure medication accordingly.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

Abbreviations/Definitions:

Alkalosis: A condition in which the body fluids have excess base (alkali). This is the opposite of excess acid (acidosis).

Anemia: A decrease in red blood cells that occurs when the body cannot properly absorb vitamin B12 from the gastrointestinal tract. Vitamin B12 is necessary for the proper development of red blood cells.

Antioxidant: A substance that has the ability to protect cells in the body against the effects of free radicals. Free radicals are molecules produced when your body breaks down food, or by environmental exposures like tobacco smoke and radiation. Free radicals can damage cells, and may play a role in heart disease, cancer and other diseases.

Ascites: Excess fluid in the space between the membranes lining the abdomen and the abdominal organs.

Bariatric Surgery: Surgical techniques in severely overweight or obese patients; patients feel full more quickly, reducing the amount of food eaten, resulting in weight loss. In Ontario, sleeve gastrectomy, the roux-en-y procedure and biliopancreatic diversion/duodenal switch are most commonly performed.). In sleeve gastrectomy, the stomach is reduced to around 15% of its original size, by permanent surgical removal of a large portion of the stomach. In roux-en-y *gastric bypass*, the stomach is made smaller by creating a small pouch at the top of the stomach using surgical staples or a plastic band. The smaller stomach is then connected directly to the middle portion of the small intestine (jejunum), bypassing the rest of the stomach and the upper portion of the small intestine (duodenum). A biliopancreatic diversion/duodenal switch changes the normal process of digestion by making the stomach smaller. The remaining part of the stomach is connected to the lower portion of the small intestine.

Calcitriol: The generic name for the prescription medication providing the man-made active form of vitamin D. Calcitriol is used in patients with kidney disease who can't make enough of the active form of Vitamin D (this conversion process is primary done in the body by the kidneys). This medication is also used to prevent and treat certain types of calcium/phosphorus/parathyroid hormone problems that can happen with long-term kidney dialysis. Calcitriol is usually used along with specific diet recommendations.

Celiac Disease: A digestive disease that damages the small intestine and interferes with absorption of nutrients from food. People who have Celiac disease cannot tolerate gluten, a protein in wheat, rye, and barley.

Cystic Fibrosis: A multi-organ disease, primarily affecting the lungs and digestive system. A build-up of thick mucus in the lungs causes severe breathing problems. It may be difficult to clear bacteria from the lungs, leading to cycles of infection and inflammation, which damage the delicate lung tissues. Thick mucus also blocks the ducts of the pancreas, preventing enzymes from reaching the intestines to digest food. People with CF

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

must consume a large amount of artificial enzymes (average 20 pills a day) with every meal and snack, to help digest and absorb adequate nutrition from food.

Diabetic Ketoacidosis: Diabetic ketoacidosis can occurs when a person with diabetes has an episode of extreme insulin deficiency. Without adequate insulin, circulating glucose from food is not available as an energy source. The body adapts by breaking down muscle, fat, and liver cells into glucose (sugar) and fatty acids for use as fuel. By-products of fat breakdown, called ketones, build up in the body causing potentially fatal consequences.

EN: Enteral Nutrition. Feeding patients through a tube placed in the nose, the stomach, or the small intestine. Placement depends on functionality of gastrointestinal tract and duration on tube feed formulation (short term through a nasogastric tube placed in nose, longer term through stomach or small intestine).

Erythropoietin: A hormone that controls erythropoietin, or red blood cell production; can be taken as a therapeutic agent to increase red blood cell production. Often used to treat anemia caused by various conditions, including chronic kidney disease, cancer and other critical illnesses.

Failure to Thrive: A description applied to children whose current weight or rate of weight gain is significantly below that of other children of similar age and sex.

Gastrectomy: Surgical removal of all or part of the stomach; used to treat bleeding, inflammation, benign or cancerous tumours.

Glycemic Index (GI): A measure of the effects of carbohydrates on blood sugar levels. Carbohydrates that break down quickly during digestion and release glucose rapidly into the bloodstream have a high GI. A lower glycemic index suggests slower rates of digestion and absorption of the foods' carbohydrates. GI teaching may help manage glucose levels in patients with diabetes.

High-Output Ostomies: Ostomies are openings in the abdomen from the small or large bowel in which intestinal waste passes out of the ileostomy and is collected in an external pouching system stuck to the skin. Some patients with ostomies experience high output which includes fluids, vitamins, minerals and electrolytes and can experience dehydration and other complications.

Ileostomy: Opening in the abdomen from the last section of the small bowel. Intestinal waste passes out of the ileostomy and is collected in an external pouching system stuck to the skin. Procedure is performed in patients that have undergone removal of large intestine from inflammatory bowel disease and/or cancer.

Inflammatory Bowel Disease: Refers to two chronic diseases that cause inflammation of the intestines: ulcerative colitis and Crohn's disease. Ulcerative colitis is an inflammatory disease of the large intestine, or colon. Crohn's disease differs from ulcerative colitis in the areas of the bowel it involves — it most commonly affects the last part of the small intestine (called the terminal ileum) and parts of the large intestine.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

However, it isn't limited to these areas and can attack any part of the digestive tract. Crohn's disease causes inflammation that extends much deeper into the layers of the intestinal wall and generally tends to involve the entire bowel wall, whereas ulcerative colitis affects only the lining of the bowel.

Ketones: Substances that are made when the body breaks down fat for energy.

Ketogenic Diet: A high-fat, low carbohydrate and adequate protein diet that is used to treat difficult-to-control epilepsy in children. The diet mimics aspects of starvation by forcing the body to burn fats rather than carbohydrates for energy. Normally. carbohydrates contained in foods are converted into glucose, transported around the body as an energy source and is particularly important in fuelling brain function. In a ketogenic diet, with very little carbohydrate intake, the liver converts fat into fatty acids and ketones. Ketones pass into the brain and replace glucose as an energy source. An elevated level of ketones in the blood, a state known as ketosis, leads to a reduction in the frequency of epileptic seizures.

Long-Term Bowel Rest: No food or water by mouth. Patients may be receiving IV fluids and/or parenteral nutrition.

NAFLD: Non-Alcoholic Fatty Liver Disease. Occurs in patients who do not consume excessive amounts of alcohol, yet they present in a similar way to what can be seen in liver disease that is due to excessive intake of alcohol (e.g., fatty liver).

NASH: Non-Alcoholic Steatohepatitis. Next stage of NAFLD that involves the accumulation of fat in the liver cells as well as inflammation of the liver.

Paracentesis: A procedure to drain fluid out of the belly through a long thin needle.

PN: Parenteral Nutrition. Intravenous feeding that provides all or part of a patient's nutrient requirements. PN differs from a standard intravenous (IV) solution as administration requires a larger vein (through placement of a peripheral or central venous catheter) to sustain the higher volume and concentration of solution that is administered. There are two types of PN: Peripheral Parenteral Nutrition (PPN) and Total Parenteral Nutrition (TPN). PPN is administered via the peripheral venous route but in lower concentrations than TPN. PPN may be partial; this means that patients may be getting nutrition from other sources (IV or oral intake) along with the PPN. PPN is often administered in patients who require short-term use, modest nutrient needs when patients may have some functionality of intestinal tract and are consuming oral intake, and/or where there are contraindications to central vein access. TPN is administered via central venous access that allows for higher rates and concentrations of the PN solution. TPN is provided when patients do not receive any other form of nutrition and is administered over longer time periods than PPN. TPN is typically administered in patients experiencing severe digestive disorders (e.g., flare-ups of inflammatory bowel disease) and patients having extended consequences of surgery, accidents or other trauma.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

PKU: Phenylketonuria. A genetic disorder that is characterized by an inability of the body to utilize the essential amino acid phenylalanine. Patients must be counselled to stay away from dietary sources of phenylalanine which includes avoiding meat, chicken, fish, eggs, nuts, cheese, legumes, cow milk and other dairy products as well as the artificial sweetener aspartame which contains phenylalanine.

Refeeding Syndrome: Usually occurs within four days of starting to feed patients who have been malnourished or who have had little nutrient intake for prolonged period of time. Patients can develop fluid and electrolyte disorders along with neurologic, pulmonary, cardiac, neuromuscular, and hematologic complications.

Secondary Hyperparathyroidism: When the body produces extra parathyroid hormone because the calcium levels are too low. This is seen when vitamin D levels are low or when calcium is not absorbed from the intestines. Correcting calcium and/or vitamin D levels will bring the parathyroid levels in the normal range.

Short Bowel Syndrome: A malabsorption disorder caused by the surgical removal of the small intestine. Short bowel syndrome usually does not develop unless more than two thirds of the small intestine has been removed. Also termed short gut syndrome or short gut.

SIADH: Syndrome of inappropriate antidiuretic hormone hypersecretion. Characterized by excessive release of antidiuretic hormone that results in the abnormal handling of water intake by the body. It is usually treated with fluid restriction. Diuretics may also be given to decrease reabsorption of water, but care must be taken not to correct water imbalances too rapidly.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

REFERENCES

Bariatrics:

AACE/TOS/ASMBS. (2008). Bariatric Surgery Guidelines. *Endocr Pract.*, 14(suppl), S109-S184.

Aills et al. (2008). ASMBS allied health nutritional guidelines for the surgical weight loss patient. *Surgery for Obesity and Related Diseases,* 4(5S), S73-S108.

Ailvarez-Leite, J. (2004). Nutrient deficiencies secondary to bariatric surgery. *Curr Opin Clin Nutr Metab Care,* 7, 560-75.

Bauman, B.A., Shaw, S., Jayatilleke, K., Spungen, A.M., & Herbert, V. (2000). Increased intake of calcium reverses: the B12 malabsorption induced by metformin. *Diab Care*, 23, 1227-31.

Biesemeier, C. K., & Garland, J. (2009). *ADA Pocket Guide to Bariatric Surgery*. Chicago: American Dietetic Association.

Clements, R. H. et al. (2006). Incidence of Vitamin Deficiency after Laparascopic roux-en-y gastric bypass in a university hospital setting. *Annals of Surgery,* 72, 1196-1202.

Cominetti et al. (2006). Zinc Nutritional Status of Morbidly Obese Patients Before and After Roux-en-Y Gastric Bypass: A Preliminary Report. *Obesity Surgery,* 16, 448-53.

Heber et al (2010). Endocrine and Nutritional Management of the Post-Bariatric Surgery Patient: An Endocrine Society Clinical Practice Guideline. *JCEM*; 95, 4823-4843.

Kushner, R.F. (2008). Managing micronutrient deficiencies in the bariatric surgical patient. In R.F. Kushner & D.H. Bessesen (Eds.), *Contemporary Endocrinology: Treatment of the Obese Patient* (379-394). Totowa, NJ: Humana Press Inc.

LeDoux et al. (2006). Comparison of Nutritional Consequence of Conventional Therapy of Obesity, Adjustable Gastric Banding, and Gastric Bypass. *Obesity Surgery,* 16, 1041-9.

Madan et al. (2006). Vitamin and Trace Mineral Levels after Laparascopic Gastric Bypass. *Obesity Surgery*: 16, 603-6.

Munoz, M., et al (2009). Iron deficiency and anaemia in bariatric surgical patients: causes, diagnosis and proper management. *Nutr Hosp.*, 24(6), 640-654.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

Malinowski, S.S. (2006). Nutritional and Metabolic Complications of Bariatric Surgery. *The American Journal of the Medical Sciences*, 331, 219-225.

Ybarra, J. et al. (2005). Unchanged hypovitaminosis D and secondary hyperparathyroidism in morbid obesity after bariatric surgery. *Obesity Surgery*, 15, 330-5.

Cardiology:

Dietitians of Canada. (2010). *Practice-Based Evidence in Nutrition (PEN) Cardiovascular Disease Practice Guidance Summary*. Available from: http://www.pennutrition.com/KnowledgePathway.aspx?kpid=2671&trid=3492&trcatid=43

Dietitians of Canada. (2005). *Practice-Based Evidence in Nutrition (PEN) Does a low hemoglobin level always indicate iron deficiency anemia? What biochemical tests can be used to differentiate anemia of iron deficiency from anemia of chronic illness?* Available from: http://www.pennutrition.com/KnowledgePathway.aspx?kpid=403&pqcatid=145&pqid=440

Ontario Health Technology Advisory Committee. (2010). *OHTAC Recommendation: Clinical Utility of Vitamin D Testing.* Available from: http://www.health.gov.on.ca/english/providers/program/ohtac/tech/recommend/rec_vitamin%20d_201002.pdf

Genest, J., McPherson, R., Frohlich, J., Anderson, T., Campbell, N., Carpentier, A., et al. (2009). 2009 Canadian Cardiovascular Society/Canadian guidelines for the diagnosis and treatment of dyslipidemia and prevention of cardiovascular disease in the adult – 2009 recommendations. *Can J Cardiol.,* 25(10), 567-579.

Critical Care:

Chadalavada, R., et al. (2010). Nutrition in hepatic encephalopathy. *Nutr Clin Pract.*, 25, 257-264.

Clay, A. S. & Hainline, B.E., (2007). Hyperammonemia in the ICU. *Chest,* 132, 1368-1378.

Crenn, P., Messing, B. & Cynober, L. (2008). Citrulline as a biomarker of intestinal failure due to enterocyte mass reduction. *Clin Nutr.*, 27, 328-339.

Fischer, J. E. & Bland, K. I. (2007) .*Multiple Organ Dysfunction Syndrome: Pathogenesis, Management & Treatment.* Philadelphia: Lippincott Williams & Wilkins.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

Fitzgibbons, S. et al. (2009). Relationship between serum citrulline levels and progression to parenteral nutrition independence in children with short bowel syndrome. *J Pediatr Surg.*, 44(5), 928-32.

Gabriell, A., Layon, A. J., Yu, M. (2008). *Civetts, Taylor & Kirby's Critical Care. (*4th ed.). (973-74). Philadelphia: Lippincott Williams & Wilkins.

Gibson, R.S. (2005). *Principles of Nutritional Assessment.* Toronto: Oxford University Press.

Manning, E. M. & Shenkin, A. (1995). Nutritional assessment in the critically ill patient. *Crit Care Clin.*, 11(3), 603-34.

Matarese, L. E. & Gottschlich, M. (2003). *Contemporary nutritional support practice: a clinical guide.* Philadelphia: Elsevier Health Sciences.

McClatchey, K. D. (2002). *Clinical Laboratory Medicine*. (2nd ed.).Philadelphia: Lippincott Williams & Wilkins.

Peracci. F. M. & Barie, P. S. (2006). Diagnosis and management of iron-related anemias in critical illness. *Crit Care Med.*, 34, 1898-1905.

Picot, D., Garin, L., Trivin, F., et al. (2010). Plasma citrulline is a marker of absorptive small bowel length in patients with transient enterostomy and acute intestinal failure. *Clin Nutr.*, 29, 235- 242.

Plauth, M. et al. (2006). ESPEN guidelines on enteral nutrition: liver disease. *Clin Nutr.*, 25, 285-294.

Prins, A. (2010). Nutritional assessment of the critically ill patients. *S Afr J Clin Nutr.*, 23(1), 11-18.

Shikora, S. A., Martindale, R. G., & Schwaitzberg, S. D. (2002). *Nutritional Considerations in the Intensive Care Unit: Science, Rationale and Practice*. Dubuque (IA): Kendall/Hunt Publishing Company.

Suyama, Y., Adachi, K., Notsu, Y. et al. (2009). Efficacy of corrected rapid turnover protein increment index (CR II) for early detection of improvement in nutritional status in patients with malnutrition. *J Clin Biochem Nutr.*, 45, 44-48.

Diabetes:

American Diabetes Association. (2008). Standards of medical care in diabetes 2008 (position statement). *Diabetes Care*, 31(Suppl 1), S12-S54.

American Diabetes Association. (2008). Nutrition recommendations and interventions for diabetes (position statement). *Diabetes Care*, 31(Suppl 1), S61-S78.

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

Andrès, E. et al. (2004). Vitamin B12 (cobalamin) deficiency in elderly patients, *CMAJ*, 171(3), 251-259.

Canadian Diabetes Association. (2008). Canadian Diabetes Association 2008 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. *Canadian Journal of Diabetes*, 32 (suppl), S1-200.

de Jager, J, et al. (2010). Long term treatment with metformin in patients with type 2 diabetes and risk of vitamin B-12 deficiency: randomised placebo controlled trial. *BMJ*, 340, 1-7. Available from: http://www.bmj.com/content/340/bmj.c2181.full.pdf

Dietitians of Canada. (2010). *Practice-Based Evidence in Nutrition Diabetes Practice Guidance Summary*. Available from: http://www.pennutrition.com/KnowledgePathway.aspx?kpid=1305&trid=16062&trcatid=43

Franz, M.J. et al. (2002). Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. (Technical Review). *Diabetes Care*, 25, 148-198.

Repchinsky, C. et al (Eds.). (2010). *Compendium of Pharmaceuticals and Specialities-The Canadian Drug Reference for Health Professionals*. Ottawa: Canadian Pharmacists Association.

Eating Disorders:

American Dietetic Association. (2006). Position of the American Dietetic Association: Nutrition Intervention in the Treatment of Anorexia Nervosa, Bulimia Nervosa, and Other Eating Disorders. *J Am Diet Assoc,* 106, 2073-2082.

Mitchell, J., Pomeroy, C., & Adson, D. (1997). Managing medical complications. In Garner, D., Garfinkel, P. (Eds) *Handbook of Treatment for Eating Disorders,* (383-393). New York, NY: The Guildford Press.

Norman, E. J. (1995). Urinary methylmalonic acid to detect vitamin B12 deficiency. *Journal of the American Medical Association,*273 (18),1420.

Pacholok, S. M. & Stuart, J. J. (2005) *Could it be B12? An Epidemic of Misdiagnoses*. New York (NY): Linden.

Yager, J., Devlin, M. J., Halmi, K. A., Herzog, D. B., Mitchell, J. E., Powers, P., & Zerbe, K. J. (2006). *Practice Guideline for the Treatment Patients with Eating Disorders*. (3rd Ed.). Available from: http://www.psychiatryonline.com/pracGuide/PracticePDFs/EatingDisorders3ePG_04-28-06.pdf

Food Allergies/Intolerances:

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.

American Gastroenterological Association (AGA) Institute. (2006). Technical review on the diagnosis and management of celiac disease. *Gastroenterology,* 131, 1981-2002.

Bianchi, M. L. (2010). Inflammatory bowel disease, Celiac disease and bone. *Arch Biochem Biophys.*, 503(1), 54-65.

Case, S. (2010). *Glute -Free Diet: A Comprehensive Resource Guide.* Regina, SA: Centax.

National Institutes of Health. (2000). Phenylketonuria (PKU): Screening and management. *NIH Consensus Statement,* 17(3), 1-33.

Presutti ,R. J., Cangemi, J. R., Cassidy, H. D.,& Hill, D. A. (2007). Celiac Disease. *Am Fam Physician*,76(12), 1795-1802.

Gastroenterology:

American Dietetic Association. (2009). Celiac disease evidence-based nutrition practice guideline. Chicago: American Dietetic Association. Available from: http://www.guideline.gov/content.aspx?id=14854

Barrett, J. S. & Gibson, P. R. (2007). Clinical ramifications of malabsorption of fructose. *Prac Gastroenterol,* 53, 51-65.

Beharry, S. et al. (2002). How useful is fecal pancreatic elastase 1 as a marker of exocrine pancreatic disease? *J. Pediatr* , 141, 84-90.

Clark, S. F. (2007). Chapter 8: vitamins and trace minerals. In Gottschlich, M. M. (Ed.). *The A.S.P.E.N . Nutrition Support Core Curriculum : A Case – Based Approach–The Adult Patient,* 129-159. Silver Springs (MD): The American Society for Parenteral and Enteral Nutrition.

Dietitians of Canada. (2008). Practice-Based Evidence in Nutrition, Hepatic Disorders Practice Guidance Summary. Available from: http://www.dieteticsatwork.com/PEN/index.asp .

Dowsett, J. (2000). An overview of nutritional Issues for the Adult with Cystic Fibrosis. *Nutrition*, 16(7/8), 566-570.

Eiden, K. (2003). Nutritional considerations in inflammatory bowel disease. *Prac Gastroenterol.* 5, 33-54.

Fessler, T. A. (2005). Trace element monitoring and therapy for adult patients receiving long-term total parenteral nutrition. *Practical Gastroenterology*, 44-65.

Hakim, F. et al. (2007). Vitamin A and E and pulmonary exacerbations in patients with Cystic Fibrosis. *J Pediatric Gastroenterology and Nutrition*, 45, 347-353.

Headstrom, P.D., Rulyak , S. J., & Lee, S. D. (2008). Prevalence of and risk factors for vitamin B(12) deficiency in patients with Crohn's disease. *Inflamm Bowel Dis.*, 14(2), 217.

Krenitsky, J. (2003). Nutrition for patients with hepatic failure. *Practical Gastroenterology*, 6, 23-42.

Krok, K. L., & Lichtenstein, G. R. (2003). Nutrition in Crohn's disease. *Curr Opin Gastroenterol.*, 19(2), 148-153.

Lee, V. (2006). Liver Dysfunction Associated with Parenteral Nutrition: What are the Options? *Practical Gastroenterology*, 6,:49-68

Lucendo, A. J., & De Rezende , L. C. (2009). Importance of nutrition in inflammatory bowel disease. *World J Gastroenterol* , 15(17), 2081-2088.

Masumoto, K. M. et al. (2001). Manganese intoxication during intermittent parenteral nutrition: report of two cases. *JPEN*, 25(2). 95-99.

McCray, S. (2003). Lactose Intolerance: considerations for the clinician. *Prac Gastroenterol,* 5, 21-39.

Misra, S. et al. (2000). Micronutrient and trace elements monitoring in adult nutrition support. *Nutr Clin Pract*, 15, 120–126.

Raymond, N. et al. (2006). The gluten-free diet: an update for health professionals. *Prac Gastroenterol,* 1, 67-92.

Shearer, CA and RC Bozian. (2007).The availability of trace elements in intravenous hyperalimentation solutions. *Ann of Pharmacothearapy* , 41, 873-877.

Sinaasappel, M. et al.(2002). Nutrition in patients with Cystic Fibrosis: a European consensus. *J of Cystic Fibrosis*, 1, 51-75.

Stephenson, A. et al. (2005). Increased vitamin A and E levels in adult Cystic Fibrosis patients after lung transplantation. *Transplantation,* 79, 613-615.

Vagianos, K., Bector, S., McConnell, J., & Bernstein, C. N. (2007). Nutrition assessment of patients with inflammatory bowel disease. *JPEN*, 31(4), 311-319.

Gerontology:

American Dietetic Association. (2004). *Manual of Clinical Dietetics*. (6th Ed.). Chicago: American Dietetic Association.

Dowsett, J. (2000). An overview of Nutrtional Issues for the Adult with Cystic Fibrosis. *Nutrition*, 16(7/8), 566-570.

Canadian Association of Nephrology Dietitians. (2008). *Essential Guide for Renal Dietitians.* Toronto: Canadian Association of Nephrology Dietitians.

Chua, E., et. al. (1999). Serum transferrin receptor assay in iron deficiency anemia and anemia of chronic disease in the elderly. *Q.J. Med*, 92, 587-594.

Fischbach, F. (2000). *A Manual of Laboratory and Diagnostic Tests*. (6th Ed.). Philadelphia: Lippincott Williams and Wilkins

Pronsky, Z. (2010). *Food and Medications Interactions*. (16th Ed.). Available from: http://www.foodmedinteractions.com/

.

Internal Medicine:

Adkins, S. M. (2009). Recognizing and preventing refeeding syndrome. *Dimensions of Critical Care Nursing,* 28(2), 53-38. Available from: http://www.nursingcenter.com/pdf.asp?AID=845148

Yanbaeva, D. G. et al. (2007). Systemic effects of Smoking. *Chest,* 131, 1557-156.

Lee, V. (2006). Liver dysfunction associated with parenteral nutrition: what are the options? *Practical Gastroenterology*, 45, 49-68. Available from: http://www.medicine.virginia.edu/clinical/departments/medicine/divisions/digestive-health/nutrition-support-team/copy_of_nutritionarticles/LeeArticle.pdf

Robinson, M. K., Trujillo, E. B., Mogensen, K. M., Rounds, J., McManus, & K. Jacobs, D. O. (2003). Improving nutritional screening of hospitalized patients: the role of prealbumin. *JPEN*, 27(6), 389-395.

McCray, S., Walker, S., & Parrish, C R.. (2005). Much ado about refeeding. Practical Gastroenterology, 30(1), 26-44. Available from: http://www.healthsystem.virginia.edu/internet/digestive-health/nutritionarticles/McCrayArticle.pdf

Yanita, M. A., & Velander R. (2009). How to recognize and respond to refeeding. *Nursing 2009 Critical Care*, 4(3). Available from: http://www.nursingcenter.com/pdf.asp?AID=860670

Kidney Disease:

Canadian Association of Renal Dietitians. (2008). *Essential Guide for Renal Dietitians*. (2nd Ed). Toronto.

Council on Renal Nutrition of the National Kidney Foundation. (2002). *Pocket guide to nutritional assessment of the patient with chronic kidney disease*. (3rd Ed.). New York: National Kidney Foundation.

Kidney Disease Improving Global Outcomes. (2009). KDIGO Clinical Practice Guidelines for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). *Kidney International,* 76, S1-S130.

Kopple, J. D. & Massry,S. G. (2004). *Nutritional Management of Renal Disease*. (2nd Ed.). Philadelphia: Lippincott, Williams and Wilkins, Philadelphia.
Council on Renal Nutrition of the National Kidney Foundation. (2002). *Pocket guide to nutritional assessment of the patient with chronic kidney disease*. (3rd Ed.). New York: National Kidney Foundation.

Pagana, K & Pagana, T. (2005). *Mosby's Diagnostic and Laboratory Test Reference*. (7th Ed.). Missouri: Elsevier Mosby.

Renal Dietitians Dietetic Practice Group of the American Dietetic Association and the Council on Renal Nutrition of the National Kidney Foundation. (2004). *Clinical Guide to Nutrition Care in Kidney Disease.* Byham-Gray. L. & Wiesen. K. A. (Eds.). Chicago: American Dietetic Association.

Oncology:

Elliott, L., Molseed, L.L., & Davis McCallum, P. (2006). *The Clinical Guide to Oncology Nutrition* (2nd ed.). Chicago: American Dietetic Association.

Gottschlich, M. M., DeLegge, M.H., Mattox, T., Mueller, C., & Worthington, P. (2007). *The A.S.P.E.N Nutrition Support Core Curriculum: A Case Based Approach-the Adult Patient.* Silver Spring, MD: American Society for Parenteral and Enteral Nutrition.

Paediatrics:

Acosta, P. B (2010). *Nutrition Management of Patients with Inherited Metabolic Disorders*. Sudbury (MA): Jones and Bartlett.

Aquilina et al. (2007). *Guidelines for the Administration of Enteral and Parenteral Nutrition in Paediatrics (*3rd Ed.). Available from: http://www.sickkids.ca/pdfs/Clinical-Dietitians/19499-Enteral_Parenteral_Nutrition.pdf

American Society of Parenteral & Enteral Nutrition (A.S.P.E.N) Board of Directors and the Clinical Guidelines Task Force. (2002). Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *Journal of Parenteral and Enteral Nutrition,* 26(1), 1SA-139SA.

Baric, I. (2008). Metylmalonic aciduria: current faces of a classical organic aciduria. *J. Inherited Metabolic Disease,* 31, 293-294.

Bergqvist, A. G., Chee, C. M., Lutchka, L., Rychik, J., & Stallings, V.A. (2003). Selenium deficiency associated with cardiomyopathy: a complication of the ketogenic diet. *Epilepsi,* 44(4), 618-20.

Carmant, L. (2008). Assessing ketosis: approaches and pitfalls. *Epilepsia*, 49(suppl 8), 20-22.

Carter, G. D. (2011). Accuracy of 25-hydroxyvitamin d assays: confronting the issues. *Curr Drug Targets*, 12(1), 19-28.

Crill, C.M., & Helms, R.A. (2007). The use of carnitine in pediatric nutrition. *Nutr in Clin Prac.* ,22, 204-213.

Gillingham, M. B., et al. (2003). Optimal dietary therapy of long chain 3-hydroxyacyl-CoA dehydrogenase deficiency. *Mol. Genet. Metab.*, 79,14-123.

Hollis, B. W. (2010). Assessment and interpretation of circulating 25-hydroxyvitamin D and 1,25-dihydroxyvitamin D in the clinical environment. *Endocrinol Metab Clin North* Am., 39(2), 271-86

Hospital for Sick Children Nutrition Team (2007). *Guidelines for the Administration of Enteral and Parenteral Nutrition in Paediatrics.* Available from: http://www.sickkids.ca/pdfs/Clinical-Dietitians/19499-Enteral_Parenteral_Nutrition.pdf

Johnson, M. A. (2000). If high folic acid aggravates vitamin B12 deficiency what should be done about it? *Clin Biochem,*. 33(5), 337-43.

Kabra, M. (2002). Dietary management of inborn errors of metabolism. *Indian Journal of Pediatrics*, 69(5), 421-426.

Kuroki, F., Matsumoto, T., & Lida, M. (2003). Selenium is depleted in Crohn's disease on enteral nutrition *Dig Dis.*, 21(3), 266-70.

Lagerstedt, S. A. et al. (2001). Quantitative determination of plasma C8 – C26 total fatty acid for the biochemical diagnosis of nutritional and metabolic disorders. *Mol. Genet. Metab.*, 73, 38-45.

Li, F., Watkins, D., & Rosenblatt, D. S., (2009). Vitamin B(12) and birth defects. *Nutr Rev.,* 67, S69-S72.

Manoli, I, Venditti, C.P. (2005). Methylmalonic Acidemia. In Pagon, R. A,, Bird, T. C., Dolan, C. R., Stephens, K. (Eds.) *Gene Reviews*. Seattle: University of Washington, Seattle.

Mitchell, L. E., Morales, M., Khartulyari, S., Huang, Y., Murphy, K., Mei ,M…Whitehead, A. S. (2009). Folate and homocysteine phenotypes: comparative findings using research and clinical laboratory data. *Clin Biochem.*, 42(12), 1275-81.

Mitsubuchi, H., Owada, M. & Endo, F. (2005). Markers associated with inborn errors of metabolism of branched chain amino acids and their relevance to upper levels of intake in healthy people: an implication from clinical and molecular investigation on maple syrup urine disease. *J. Nutr.*, 135, 1565S-1570S.

Parris, M. K. (2010). Vitamins D and K as pleiotropic nutrients: clinical importance to the skeletal and cardiovascular systems and preliminary evidence for synergy.. *Altern Med Rev.*, 15(3), 199-222.

Ray, J.G., Cole, D. E., & Boss, S. C. (2009). An Ontario-wide study of vitamin B12, serum folate, and red cell folate levels in relation to plasma homocysteine: is a preventable public health issue on the rise? *Mol Genet Metab.,* 98(1-2), 166-72.

Spiekerkotter, U., et al. (2000). Very long chain acyl-coenzyme A dehydrogenase (VLCAD) deficiency: monitoring of treatment of carnitine/ acylcarnitine analysis in blood spots. *Acta Paediatr.*, 89, 492–495.

Pregnancy:

American Dietetics Association. (2002). Position paper of the American Dietetic Association: nutrition and lifestyle for a healthy pregnancy outcome. *JADA,* 102(10), 1479-1490.

Berge, H., Crane, J., Farine, D. (2002). SOGC clinical practice guidelines ccreening for gestational diabetes mellitus. J*OGC*, 121, 1-10.

Bothwell, T. H. (2000). Iron requirements in pregnancy and strategies to meet them. *Am J Clin Nutr.,* 72(suppl), 257S–64S.

Hamilton, Stuart A. et al. (2010) Profound Vitamin D Deficiency in a Diverse Group of Women during Pregnancy in a Sun-Rich Environment at Latitude 32 degress N. *International Journal of Endocrinology*. Available from: http://downloads.hindawi.com/journals/ije/2010/917428.pdf

Health Canada. (2009). *Prenatal Nutrition Guidelines for Health Professional–Folate Contributes to a Healthy Pregnancy*. Available from: http://www.hc-sc.gc.ca/fn-an/pubs/nutrition/folate-eng.php

Health Canada. (2009). *Prenatal Nutrition Guidelines for Health Professionals – Iron contributes to a healthy pregnancy*. Available from: http://www.hc-sc.gc.ca/fn-an/pubs/nutrition/iron-fer-eng.php

Institute of Medicine of the National Academies. (2009). *Report Brief: Weight Gain During Pregnancy: Reexamining the Guidelines.* Available from: http://www.nap.edu/catalog.php?record_id=12584

Johnson, Donna D. et al. (2011). Vitamin D deficiency and insufficiency is common during pregnancy. *American Journal of Perinatology*, 28(1), 7-12.

Molloy, A. M., Kirke, P. N., Troendle, J. F., Burke, H., Sutton, M., Brody, L. C., Scott, J. M., & Mills, J. L. (2009). Maternal vitamin B12 status and risk of neural tube defects in a population with high neural tube defect prevalence and no folic Acid fortification. *Am J Clin Nutr.,* 89(2), 712S-6S.

Milman, N. (2006). Iron prophylaxis in pregnancy—general or individual and in which dose? *Ann Hematol* 85: 821–828

Ministry of Health Services British Columbia. (2010). *Guidelines and Protocols (Advisory Committee): Iron Deficiency–Investigation and Management.* Available from: http://www.bcguidelines.ca/gpac/guideline_iron_deficiency.html

Wagner, Carol L., et al (2010). Circulating 25-hydroxyvitamin D levels in fully breastfed Infants on oral vitamin D supplementation. *International Journal of Endocrinology*. Available from: http://downloads.hindawi.com/journals/ije/2010/235035.pdf

Sports Nutrition:

Andrews, N, C. (2004), Commentary. Anemia of inflammation: the cytokine-hepcidin link. *J. Clin Invest,* 113(9), 1251–1253.

Armstrong, L. E. et al. (1998). Urinary indices during dehydration, exercise, and rehydration. *Int. J. Sport Nutr.*, 8, 345-355.

Chatard, J.C., et. al. (1999). Anaemia and iron deficiency in athletes practical recommendations for treatment. *Sports Med.,* 4, 229-240.

Cowell, B. S., Rosenbloom , C. A., Skinner, R., & Summers , S. H. (2003). Policies on screening female athletes for iron deficiency in NCAA division I-A nstitutions. *Int J Sport Nutr Exerc Metab.*, 13, 277-285.

Dietitians of Canada, American Dietetic Association and American College of Sport Medicine. (2009). *Joint Position Paper: Nutrition and Athletic Performance.* Available from: http://www.dietitians.ca/Downloadable-Content/Public/noap-position-paper.aspx

Food and Nutrition Board, Institute of Medicine. (2008). *Dietary Reference for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, , Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc.* Washington, D.C.: National Academy Press. Available from: http://www.nap.edu/books/0309072794/html/

Karl, P. J., et. al. (2010). Randomized, double-blind, placebo-controlled trial of an iron-fortified food product in female soldiers during military training: relations between iron status, serum hepcidin, and inflammation. *Am. J. Clin. Nutr.*, 92, 93–100.

Rodenberg, R. E., & Gustafson, S. (2007). Iron as an ergogenic aid: ironclad evidence? *Current Sports Medicine Reports*, 6, 258-264.

Willis, K. S, Peterson N. J., & Larson-Meyer, D. E. (2008). Should we be concerned about the vitamin D status of athletes? *Int J Sport Nutr Exerc Metab.,* 18(2), 204-24.

Woolf, S. T., Thomas, M. M., Hahn, N., Vaughn, L., Carlson, A. G, & Hinton, P. (2009). Iron status in highly active and sedentary women. *Int J Sports Nutr Exerc Metab.,* 19, 519-533.

The College would like to express our sincere gratitude and appreciation to the following RDs for their contributions in 2011 to the 14 lab test expert advisory panels that make up the bulk of this lab test list. In addition, we greatly appreciate the RDs who provided input in our 2017 member consultation. This input resulted in revisions to the 2011 lab test list to provide a current 2018 list for the Ministry's cost forecasting purposes.

Bariatrics
Jennifer Brown
Denise Poirier
Sue Ekserci
Katie Warwick
Karen Coulman

Cardiology
Kimberly Butt
Barbara Cantwell
Marjan Shalchi
Daphna Steinberg

Cardiology
Elaine Lo
Kristen MacEachern
Mary Morningstar
Paul Morretti
Jill Pikul

Diabetes
Patricia Baker
Wendy Gamblen
Grace Lee
Michele MacDonald Werstuck
Beth MacEachern
Michelle Saraiva

Eating Disorders
Tracie Burke
Madelyne Campbell
Jessica Cane
Holly Dickenson
Jill Fraleigh

Food Allergies/Intolerances
Andrea Carpenter
Johanna Kaipainen
Sarah Conly
Johanne Saab

Gatroenterology
Andrea Firmin
Suzanne Hansen
Janet Madill
Meera Mathius
Barbara Wendland

Gerontology
Marry Farris
Carol Paulic
Bev Sikorski
Heather Toll

Internal Medicine
Linda Ahn
Heather Barron
Tiffany Krahn
Elke Sengmueller

Kidney Disease
Linda Cerullo
Lynsay Clark
Kim Fisher

Oncology
Stella Chiu
Susan Haines
Joanne MacNeil
Patricia Forster

Pediatrics
Laura Burr
Jennifer Fabe
Joan Jory
Amy Pender
Rivanna Stuhler
Roya Riazi

Pregnancy
Jennie Addario
Marg Alfieri
Angela Cuddy

Sports Nutrition
Susie Langley
Neil Mackenzie
Beth Mansfield
Margaret Pereira
Nicole Springle

- Glossary of abbreviations and *italicized* items, p. 40-43.
- References, p. 44-55.