Dietitians of Canada
Les diététistes du Canada

Hepatitis C: Nutrition Care

Canadian Guidelines for Health Care Providers

Endorsed by:

- Canadian Association for the Study of the Liver
- Canadian Association of Hepatology Nurses
- Canadian Hemophilia Society
- Canadian Liver Foundation
- Hepatitis C Society of Canada

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These guidelines are designed to serve as a general framework to assist decision making for nutritional management of patients infected with the hepatitis C virus and are based on the best information available at the time of publication. The particular needs of individuals infected with the hepatitis C virus will determine how these guidelines are used. The skill and judgement of the health care provider is important in making health care decisions.

The opinions expressed in this document do not necessarily reflect the official policies or views of Health Canada.

This document, as well as an online professional education program and patient education handouts, are available from the Dietitians of Canada website at <www.dieteticsatwork.com>.
Permission is granted to download and reproduce the documents in their entirety.

Également disponible en français sous le titre, *Hépatite C : Soins nutritionnels – Lignes directrices canadiennes pour les intervenants de la santé*.

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Executive Summary

These guidelines are directed to all health care providers who are in a position to offer nutrition-related advice and guidance to persons infected with the hepatitis C virus (HCV), in all stages of the disease. The guidelines are based on the best information available at the time of publication; where scientific evidence is not available, best-accepted practice is presented.

The prevalence of HCV infection in Canada is estimated to be about 0.8%, or 240,000 persons. Hepatitis C is one of the driving forces behind the increasing prevalence of chronic liver disease. Up to 85% of persons exposed to HCV develop chronic liver disease over a 10- to 40-year period. Associated morbidity and mortality are projected to increase dramatically over the next 10 to 15 years. An increase in chronic hepatic disease means potential problems with nutritional deficits in this population and an important role for nutrition in the outcome of the disease.

A Primer on Hepatitis C

HCV causes an inflammatory reaction that is localized within the liver, allowing the virus to gradually infect and destroy liver tissue, such that liver damage progresses slowly. It is not unusual for someone who feels well to have serious liver disease and for someone with severe symptoms to have only mild liver disease. Liver failure does not become obvious until most of the hepatocytes have been destroyed. At this point, it becomes difficult for the body to maintain nutritional homeostasis, utilize nutrients appropriately, synthesize plasma proteins, and detoxify noxious substances.

The Liver and Nutrition

The liver significantly influences nutritional status through its role in the intermediary metabolism of macronutrients, micronutrients and bile salts. Liver disease affects nutrient digestion and absorption, storage and metabolism, which can lead to vitamin and mineral deficiencies and protein–energy malnutrition (PEM). The degree to which nutritional factors contribute to the progression of liver disease has not been well established. It is not known whether poor nutrition increases the viral activity of HCV, or speeds the progression of liver damage due to the virus. However, as the primary metabolic organ, damage to the liver will have an important impact on nutritional intake and overall nutritional status in this population.

Healthy Lifestyle Overview

Subtle nutritional deficits may not be obvious at the early stages of HCV infection. Ideally, nutrition and healthy lifestyle should be discussed as early as possible to promote well-being and quality of life. More specialized advice becomes important as the disease progresses.

Healthy eating is well recognized as an important component of health. Diet is an important part of the overall management of HCV and may enhance the response to treatment and its side effects. *Canada's Guidelines for Healthy Eating* and *Canada's Food Guide to Healthy Eating* are generally appropriate for persons infected with HCV.

Physical activity will not affect the course of infection, but it can help relieve symptoms of tiredness, stress and depression, improve appetite, build up the immune system, and improve a patient's sense of well-being. Moderate exercise as outlined in *Canada's Physical Activity Guide to Healthy Active Living* is recommended for all patients with hepatitis C who are not experiencing decompensated cirrhosis or other metabolic complications.

Alcohol intake is a cofactor in the rate of progression of chronic HCV infection. In the absence of scientific evidence for a safe intake level, a prudent recommendation is for the person with HCV infection to avoid alcohol use.

Nutrition Intervention in Hepatitis C

Nutrition care for persons infected with HCV aims to promote optimal nutritional status, prevent or treat malnutrition or deficiencies in specific nutrients and potentially hinder progression of the disease. Nutrition care should be a component of the total health care provided to persons infected with HCV.

In general, persons infected with HCV do not need to follow specific dietary restrictions unless they have advanced liver disease or some other condition such as diabetes or celiac disease that requires dietary modification. Adjustments in macronutrients, electrolytes, fluids, vitamins and minerals may be indicated in these circumstances.

Assessment of Nutritional Status

Screening of nutritional status for early identification of nutrition-related problems is vital to successful treatment and to prevention of more serious problems. A complete nutrition assessment includes a review of medical history and risk factors, medication profile, nutritional profile (including appropriate anthropometrics, body composition, evaluation of dietary intake, and comparison with estimated needs), biochemical evaluation, notation of psychosocial and economic conditions, changes in routine, symptoms that interfere with nutritional well-being, and prognosis.

Symptoms and Treatment Side Effects

Many persons with HCV experience discomforts, due either to symptoms of the disease or to side effects of treatment. Most patients who undergo treatment for hepatitis C experience side effects; however, not everyone experiences the same side effects from the same treatment, nor can the severity be predicted. Nutritional measures can help manage discomforts.

Complementary and Alternative Therapies

Many persons with hepatitis C are interested in complementary or alternative medicine (CAM) remedies, especially when the virus has failed to respond to antiviral treatment. No herbal, diet supplement, or alternative medicines have been proven to cure — or even relieve symptoms of — hepatitis C. Some can be hepatotoxic or interfere with prescribed medicines. At this point, all such treatments should be considered experimental.

Nutritionally At-Risk Groups

Two categories of persons with hepatitis C would be considered to be nutritionally at risk, either due to concomitant medical conditions (e.g. HIV, diabetes, renal disease) or as a member of an at-risk population or lifestyle group (e.g. children, Aboriginal peoples, those who use alcohol and other substances, those who live in poverty and/or with violence).

Skills for Healthy Eating

Persons with HCV may face challenges related to skills required for healthy eating (e.g. budgeting, meal planning, grocery shopping, preparing healthy meals), as well as additional challenges due to a limited budget, limited energy, nausea and food aversions.

Practice Essentials

These action steps are provided to give guidance to health care providers in the practical application of the nutrition guidelines when providing advice to a patient infected with HCV. For more in-depth background information, consult the respective chapters.

Chapter 1: A Primer on Hepatitis C

- Make prevention of HCV infection a priority. See the section in *Chapter 1* that outlines risk factors for transmission.
- Ensure screening of patients presenting with risk factors and symptoms of HCV infection. The severity of symptoms is not a reliable indicator of the seriousness of liver disease. The disease often progresses without symptoms until significant damage has occurred.
- Advise women infected with HCV who plan to nurse about proper care of nipples to avoid cracking or bleeding. If those problems do occur, women should be advised to discontinue breastfeeding until the nipples heal. They may need to pump and discard breastmilk to keep up their milk supply. A lactation consultant may be a valuable resource.

Chapter 2: Healthy Lifestyle Overview

Encourage persons with HCV to obtain optimal nutritional status through a balance of food intake, physical activity and medication (if required) to enhance their immune system and promote liver regeneration. Individualize specific dietary recommendations and medications to accommodate the person's preferences and lifestyle. Remember that some persons infected with HCV may need reminding of the health benefits and pleasures of good food, physical activity and adequate rest and relaxation.

A healthy diet for persons infected with HCV includes:

- a variety of foods from all four food groups of *Canada's Food Guide to Healthy Eating*
- adequate but not excessive energy intake, spread out over the day
- adequate protein intake for fighting infection and for liver regeneration
- plenty of vegetables and fruit to maximize free radical-fighting antioxidants (emphasize variety and colour)
- foods that are rich in vitamin A and vitamin C
- avoidance of alcohol to protect the liver and allow it to regenerate
- limited high fat and high sugar foods
- food intake balanced with some activity, within physical limitations

Healthy Eating

- Discuss nutrition and healthy lifestyle as early as possible to promote well-being and quality of life. Subtle nutritional deficits are not always obvious at early stages of the disease.
- Advise patients with hepatitis C that they do not need to follow specific dietary restrictions unless they have advanced liver disease or some other condition such as diabetes or celiac disease that requires dietary modification. (*See Chapter 7.*) More specialized advice becomes important as the disease progresses. *(See Chapter 3.)*
- Assess as early as possible whether a patient's eating patterns generally follow *Canada's Food Guide to Healthy Eating* (CFGHE) by including a variety of foods from all four food groups. See the Healthy Eating Checklist (*Appendix A*) for suggested questions to generally assess the quality of the patient's eating pattern. Use the Checklist as a quick tool to help determine if there is a need for further dietary assessment. Consult CFGHE (*see Resources section for Chapter 2*) and discuss *Appendix B*: Canada's Food Guide Principles.
- See daily food guides for vegetarians when appropriate. (*See Resources section for Chapter 2.*)
- Ensure that dietary advice is accurate, specific and sufficiently detailed to empower the patient to act on it. Avoid providing general advice like "eat a healthy diet" which is open to interpretation and will be ineffective if people believe their diet is already healthy.
- Offer ongoing support and encouragement to patients trying to improve their eating pattern. Even a "normal healthy diet" may seem restrictive to people whose former diet has been very "unhealthy".
- Consult the local public health office or community health centre for more information and resources on healthy eating.

Practice Essentials

- Advise a patient with more advanced liver disease to seek more specific advice. (See *Chapter 3.*) Consult the Practice Essentials for *Chapter 3* for advice on when to refer patients to a registered dietitian for individualized assessment and counselling.
- See *Chapter 7* for information on patients at high nutritional risk due to concomitant medical conditions or as a member of an at-risk population or lifestyle group.
- See *Chapter 8* for information on skills for healthy eating, including food budgeting, meal planning and preparation, grocery shopping and reading nutrition labels.

Alcohol

- Recommend alcohol avoidance. In the absence of scientific evidence for a safe intake level, a prudent recommendation is for the person with HCV infection to abstain from the use of alcohol, particularly when taking certain medications, including antiviral treatment. *(See the Chapter 7 Practice Essentials and text for additional guidance.)*

Healthy Body Weight and Physical Activity

- Assist patients infected with HCV to establish healthy attitudes about body weight and body image and to adopt healthy eating and activity patterns that will help them achieve and maintain a healthy weight throughout life.
- Assess the patient's weight. In early stages of HCV infection, use Body Mass Index (BMI). Consult *Chapter 4* for alternative anthropometric measurements in the presence of ascites and other fluid shifts.
  - Advise those who are obese of the potential for more rapid disease progression and encourage them to follow a healthy eating pattern and engage in regular physical activity to promote gradual weight loss of 10% body weight. Although sustained weight loss may be difficult to achieve, it may be associated with a reduction in steatosis and abnormal liver enzymes and an improvement in fibrosis, despite the persistence of the virus. Advise patients to avoid crash diets or fads that promise more than they can deliver.
  - Advise those who are within a healthy BMI range that their weight is in a range generally considered healthy.
- Advise patients to monitor their weight regularly. If they have difficulty maintaining their weight, they should consult their health care provider to be assessed further to determine and treat the cause.
- Recommend moderate physical activity for all patients with hepatitis C who are not experiencing decompensated cirrhosis or other metabolic complications. Remind patients infected with HCV of the benefits of being moderately active. For example, physical activity can help improve appetite and relieve other discomforts associated with the disease or its treatment *(see Chapter 5*), and can help reduce feelings of stress.
- Caution individuals who were previously sedentary that they may unconsciously compensate for added periods of mild to moderate intensity exercise by reducing other activities during the remainder of the day.
- Remind patients of safety precautions, such as checking with a doctor before starting an exercise program, participating at a comfortable level, taking rest breaks, increasing activity levels slowly, and being sensible (taking a day or two off when feeling more tired than usual). (*See Appendix C.*)
- Remind patients that physical activity does not have to be difficult or take a lot of time to be beneficial. A daily walk or swim at their own pace will help. Encourage them to slowly build physical activity into their daily lives (15 to 30 minutes, 3 to 5 days a week). Help them find a variety of activities from all three types (endurance, strength and flexibility) that they can enjoy. Use the tips in *Appendix C* as a starting point.
- Recommend that HCV-infected patients who are debilitated or are non-exercisers consult a physiotherapist.

Chapter 3: Nutrition Intervention in Hepatitis C

- Assess whether adjustments in macronutrients, electrolytes, fluids, vitamins and minerals may be indicated. This depends on the severity of liver disease and presence of other medical conditions. See the tables in this section summarizing the nutrition recommendations in the various stages of hepatitis C infection; see *Chapter 3* for more detail.
- Be aware of factors that can have an impact on dietary intake (nausea, anorexia and early satiety, change in taste acuity, therapeutic dietary restrictions, or etiology and severity of the liver failure), and act quickly to counter any problems.
- Do not routinely recommend low protein diets as they promote further malnutrition. They are definitely not appropriate for patients who do not have symptoms of hepatic encephalopathy (HE), and are not suggested as a means of preventing HE in patients who do not have symptoms. See *Appendix D:* Quick Protein Check.
- Monitor weight regularly. An unintentional change of 10% or more requires attention.
- See *Chapter 5* for ways to help patients cope with discomforts related to symptoms of the disease or to side effects of medication.
- Refer patients at high nutritional risk to a registered dietitian for nutritional assessment and counselling. *(How to locate a registered dietitian, see general Resources.)*

Who Should Be Referred to a Registered Dietitian?

Persons with HCV infection can potentially benefit from consultation with a registered dietitian, as they often have special nutrition needs and/or nutrition-related questions or issues. The following list indicates those persons at higher risk who are a priority for consultation:

- persons with advanced liver disease
- experiencing symptoms such as nausea, diarrhea, anorexia (reduced appetite) or unplanned weight change of 10% or more that may be helped by dietary modification
- with co-existing conditions, such as HIV, alcohol dependency, renal disease, diabetes or pregnancy
- with BMI<20 (based on estimated dry weight if ascites is present)
- with BMI>30
- requiring a sodium-restricted diet
- with poor appetite and food intake lasting more than several days
- who avoid an entire food group

Vitamin / Mineral Supplements

- Always consider foods as the first choice for meeting nutritional requirements. **A multivitamin with minerals** can be useful to prevent potential deficiencies associated with poor intake, the metabolic disturbances of liver disease, and drug effects. A multivitamin with minerals may be appropriate for those with hepatitis C, particularly if appetite or food selection is poor. See *Chapter 3* for information on choosing an appropriate multivitamin and mineral supplement.
- Recommendations for the use of **individual vitamin or mineral supplements** to improve individual diets should come from physicians or registered dietitians applying current scientific knowledge after individual dietary and nutrition assessment. Vitamin and mineral supplementation for therapeutic purposes should be done only under the supervision of a physician. Information concerning Canadian nutritive supplements is accessible on Health Canada's Drug Products website. (*See general Resources.*)
- Advise patients taking vitamin or mineral supplements not to exceed the recommended doses as excesses of some nutrients can be harmful or may be an additional source of stress to the liver.
- At this time, antioxidant therapy (e.g. vitamin E, vitamin C, selenium) should be restricted to randomized, controlled clinical trials in which treatment effects can be closely monitored and therapeutic efficacy can be determined with scientific accuracy.

Cirrhosis

- Encourage patients with cirrhosis to consume a modified meal pattern with frequent, small meals 4 to 7 times per day, including an evening snack. This has been found to improve nitrogen and substrate utilization, diminish fat and protein oxidation and prevent depletion of glycogen stores.
- Be aware that nutrient needs in patients with compensated cirrhosis are similar to those with acute HCV infection or pre-cirrhosis.

Practice Essentials

Decompensated Cirrhosis

- Consider specific dietary modifications for associated complications, which include ascites, hepatic encephalopathy (HE) and hepatic bone disease. Health care providers who are not familiar with these topics can contact registered dietitians working in those areas for best practice.
- If nutritional intake is inadequate by the oral route, consider the enteral route. Formulae should be high energy (1.5 kcal/mL) with a lower sodium content (40 mmol/day), so they can be used readily by patients with fluid retention.
- Advise patients preparing for transplantation surgery that nutritional therapy can have a beneficial effect on clinical outcomes and well-being.

Protein Intolerance

- Be aware that protein restriction is usually not required. Determine the cause of HE. Consider treatment with lactulose to relieve symptoms. In general, dietary protein is limited only in patients with acute HE or refractory HE not attributable to another cause such as gastrointestinal bleeding, infection, dehydration, lactulose non-compliance, or constipation. Prolonged low protein diets are not considered appropriate for chronic HE; resume normal protein intake by gradual increments as soon as possible.
- Consider the prudent use of branched-chain amino acids (BCAA) for selected cirrhotic patients who have intolerance to usual dietary proteins. BCAA can be used to keep patients in positive nitrogen balance when they are not responsive to medication, are in a coma and not improving, or when the cause of HE cannot be found.

Ascites

- When ascites is kept in check, patients may experience some relief from early satiety.
- Treatment for ascites can include dietary sodium restriction, diuretics, and sometimes fluid restriction or other fluid removal measures.

Sodium restriction

- Generally, no more than 2000 mg/day (87 mmol) of sodium should be ingested to minimize water retention and facilitate blood pressure control. In severe cases of ascites, further restriction may be necessary (44–87 mmol). Keep in mind that sodium restriction may impair oral intake.
- Evaluate the history of the usual eating pattern before diet instruction is provided. Patients who have a very compromised food intake may not require a less-palatable sodium-restricted diet to stay within an acceptable sodium intake.
- Reduction in sodium intake can involve avoidance of salty foods, salt in cooking, and salt at the table. Most fresh foods tend to be lower in sodium while many prepared foods are higher in sodium. Suggest that lemon juice and herb/spice mixtures without sodium be used as salt substitutes. See *Appendix E* for food selection guidelines.
- Food labels are an important source of information on sodium content; teach the patient how to evaluate food labels and identify foods high and low in sodium. *(See Chapter 8.)*
- Provide guidance to patients who will be eating meals away from home, as meals obtained at restaurants, especially fast-food restaurants, and convenience meals tend to be high in sodium.
- Identify regular use of substances other than foods that contain sodium, such as antacids, and incorporate them into the daily sodium allowance if necessary.
- Consider potassium replacement with the use of potassium-wasting diuretics. If potassium intake from foods is insufficient to replace losses, supplements may be necessary.

Malabsorption

- Assess patients with hepatitis C who are suspected of having malabsorption for signs of nutrient deficiency and treat them on an individual basis as required.

Steatorrhea

- Consider medium-chain triglycerides (MCTs) to supplement the diet if steatorrhea occurs as they do not require bile salts for absorption. It should be noted that MCTs do not contain essential fatty acids. They can be used like other oils, in cooking, baking and salad dressings.
- If steatorrhea is >10 g/d, supplementation of fat-soluble vitamins (A, D, E, K) may be necessary. Water-soluble forms of these vitamins are available by prescription.

A. Guidelines for Macronutrients, Electrolytes and Fluids in Hepatitis C

Disease Stage	Guidelines						Intervention Goals & *Other Considerations
	Macronutrients				Sodium (per day)	Fluids‡ (per day)	
	Protein (g/kg/d)	Energy† (kcal/kg/d)	%CHO	%Fat			
General comments	-restrict only in acute HE or refractory HE when cause cannot be found	-average energy needs are higher in HCV infection than healthy population	-no restriction in absence of glucose intolerance	-no routine restric-tion	-no restriction in absence of ascites	-need is governed by thirst -restriction in hyponatremia <120 mmol/L	overall goals: -prevent malnutrition -prevent vitamin and mineral deficiencies -maintain healthy lifestyle
Acute Hepatitis **Chronic Hepatitis (no cirrhosis)**	1.2–1.5	25–40 *or* 1.1–1.4 X BEE (to achieve or maintain IBW)	50–55	30–35		1 mL/kcal *or* 35 mL/kg (20–55 y) 30 mL/kg (55–75 y)	-prevent malnutrition -enhance regeneration of liver cells -slow disease progression *no sodium or protein restriction *follow CFGHE and CPAGHAL
Cirrhosis -compensated	1.2–1.5	25–40 *or* 1.1–1.4 X BEE	50–55	30–35			-prevent malnutrition *no sodium or protein restriction
Cirrhosis -decompensated ascites severe ascites		add 10%	50–55	30–35	2 g (87 mmol) 1–2 g (44-87 mmol)	restriction may be needed 1.0–1.5 L	*fluid restriction may be necessary if ascites is present; if serum Na <120 mmol/L after Na restriction and diuretic adjustment *consider concentrated enteral or parenteral formula if fluid restriction is required *monitor compliance to Na restriction with 24-h urine Na *monitor K when using K-wasting diuretics; supplement as needed
malnutrition	1.2–1.8	35–45 *or* 1.5–1.75 X BEE	50–55	30–35			-restore normal nutrition *start nutrition support slowly; consider potential for refeeding syndrome *offer small, frequent meals of high-energy, high-protein foods
cholestasis	1.2–1.5	35–45 *or* 1.5–1.75 X BEE	50–55	30–35			-prevent malnutrition -treat fat malabsorption *if weight loss, consider MCT supplements
acute encephalopathy refractory	0.6–0.8 until cause is diagnosed consider 0.6 standard + 0.6 BCAA	25–35	50–55	30–35			-prevent malnutrition *seek and correct the cause of HE -resume normal protein intake as soon as possible; increase in increments of 0.25–0.5 g/kg dry weight
chronic encephalopathy	1.2–1.5		50–55	30–35			*consider BCAA if patient with severe HE fails to tolerate adequate amounts of standard protein

Disease Stage	Guidelines						Intervention Goals & *Other Considerations
	Macronutrients				Sodium (per day)	Fluids‡ (per day)	
	Protein (g/kg/d)	Energy† (kcal/kg/d)	%CHO	%Fat			
Liver transplant							
pretransplant							-improve outcome -prevent or treat malnutrition -restore normal nutrition
stable	1.2–1.5	25–40 or 1.1–1.4 X BEE	50–55	30–35			
malnourished	1.2–1.8	35–45 or 1.5–1.75 X BEE					
posttransplant							-enhance recovery -prevent malnutrition *adjustments made based on frequent reassessment of data
short term (1–2 months)	1.2–2.0	30–45 *or* 1.2–1.75 X BEE	50–55	30–35	may need 3–5 g (NAS diet) if previous ascites		
long term	0.8–1.0	to maintain healthy body weight					-manage common chronic health problems associated with transplantation (obesity, diabetes, dyslipidemia, hypertension) -maintain healthy lifestyle

Notes:

†In overweight or obese patients, use ideal or adjusted weight to avoid overestimate.
In patients with significant ascites and edema, use adjusted body weight (usually a reference desirable weight or an estimated dry weight).

‡Fluid requirements are higher in those with fever, vomiting or diarrhea.

CHO = carbohydrate; IBW = ideal body weight; BEE = basal energy expenditure as estimated by the Harris–Benedict equation; CFG = *Canada's Food Guide to Healthy Eating;* CPAGHAL = *Canada's Physical Activity Guide to Healthy Active Living*; BCAA = branched-chain amino acids; MCT = medium-chain triglycerides; NAS = no added salt diet (3–5 g Na)

Guidelines summary prepared based on the following sources as well as accepted practice. For additional detail, see *Chapter 3*.

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B. Guidelines for Vitamins and Minerals in Hepatitis C

Nutrients	Guidelines[1–4]		Considerations/Research Results‡
	RDA (or AI) for healthy adults 19+ y	UL for healthy adults 19+ y	
SUPPLEMENTS			-foods are always first choice for meeting nutritional requirements -biochemical data and clinical manifestations will determine the need and the dose -recommendations should come from physician or registered dietitian after individual assessment
Multivitamin + Mineral			-multivitamin/mineral is prudent in HCV infection, particularly if appetite or food selection is poor -include some vitamin A, C, E, selenium, zinc, B-vitamins, folate -no iron if patient has high iron stores or cirrhosis (i.e. formula for men/older adults)
Antioxidant Therapy			-some antioxidants can also be pro-oxidants -restrict antioxidant therapy (i.e. high-dose vitamin E, vitamin C, selenium) to experimental conditions
VITAMINS			-vitamin deficiency is common in cirrhosis -supplement when deficiency recognized
Fat-soluble			-monitor status -if steatorrhea >10 g/d consider water-miscible form[5] (e.g. ADEKS)
A†	female 700 mcg (2300 IU) male 900 mcg (3000 IU)	3000 mcg (10,000 IU)	-serum retinol not valid as sole indication of need to supplement -excess vitamin A can be hepatotoxic; avoid routine supplementation above level in multivitamin -no toxicity reported with plant sources -hepatotoxicity is enhanced with ethanol
D	**AI** 19–50 y: 5 mcg (200 IU) 51+ y: 10 mcg (400 IU)	50 mcg (2000 IU)	-assess levels in cirrhosis; if low, consider supplementation with liver-activated form (Rocaltrol®) -excess vitamin D can be hepatotoxic
E	15 mg	1000 mg from supplements or fortified foods	
K	**AI** female 90 mcg male 120 mcg	ND	-clinical deficiency sign: easy bruising -injections may be required in severe liver disease with clinical signs of deficiency -assess INR in cirrhosis -in absence of UL, exercise caution in exceeding AI
Water-soluble			
Thiamine	female 1.1 mg male 1.2 mg	ND	-may have antiviral properties -in absence of UL, exercise caution in exceeding RDA
Niacin	female 14 mg male 16 mg	35 mg	-hepatotoxicity reported with unmodified and particularly time-release preparations -avoid supplementation above level in multivitamin
Folic acid	400 mcg	1000 mcg from supplements	-RBC levels can be screened if deficiency suspected
B_6	19–50 y: 1.3 mg 51+ y: female 1.5 mg male 1.7 mg	100 mg	-serum levels can be screened if deficiency suspected
B_{12}	2.4 mcg	ND	-in absence of UL, exercise caution in exceeding RDA
C	female 75 mg male 90 mg	2000 mg (lower in conditions associated with increased iron storage in the liver)	-deficiency reported in Porphyria Cutanea Tarda -persons with HCV and cirrhosis or elevated iron stores should probably avoid high-dose vitamin C supplementation until safety has been established (possible pro-oxidant with high liver iron stores) -in general, vitamin C supplementation above level in multivitamin is not recommended

Nutrients	Guidelines[1–4]		Considerations/Research Results‡
	RDA for healthy adults 19+ y	UL for healthy adults 19+ y	
MINERALS			-supplement when deficiency recognized
Calcium	19–50 y: 1000 mg 51+ y: 1200 mg	2.5 g	-deficiency is common in cirrhosis -assess intake -screen vitamin D levels in cirrhosis -posttransplant: 1500–2000 mg/day calcium from food and supplements + 400–800 IU/day vitamin D
Iron	female 19–50 y: 18 mg 51+ y: 8 mg male 8 mg	45 mg	-elevated hepatic iron levels may contribute to fibrosis and inhibit antiviral treatment -elevated serum iron or cirrhosis: avoid iron supplements, restrict intake of iron-rich foods, avoid iron-coated cookware -in others, avoid exceeding dose in a multivitamin/mineral -iron therapy may be indicated in patients with esophageal or gastrointestinal bleed; treat only as long as necessary
Magnesium	female 19–30 y: 310 mg 31+ y: 320 mg male 19–30 y: 400 mg 31+ y: 420 mg	350 mg from supplements	-deficiency signs include muscle cramps, fatigue, weakness, nausea, vomiting -deficiency is common in cirrhosis -deficiency can occur due to diuretics -screen levels in cirrhosis; supplement with 500 mg magnesium gluconate tid as needed -supplements may cause diarrhea
Selenium	55 mcg	400 mg	
Zinc	female 8 mg male 11 mg	40 mg	-deficiency signs include reduced taste acuity, taste alterations -deficiency is common in cirrhosis -supplement with 220 mg zinc sulfate tid X 3 months if deficiency suspected -consider trial of zinc supplementation in chronic HE

Notes:
†IU calculation: 1 mcg retinol = 1 mcg preformed vitamin A from supplements; 1 IU = 0.3 mcg of all-trans retinol
Although the UL for vitamin A is set for total intake of preformed retinal equivalents from all sources, due to the high dietary variability of vitamin A intake and the complexity of distinguishing preformed retinol equivalents from food, it may be more practical to consider only supplemental vitamin A intakes in relation to the UL.

ND = not determinable; INR = International Normalized Ratio; RBC = red blood cell count; tid = three times/day

‡Considerations are based on the following sources and accepted practice. For additional detail, see *Chapter 3*.

Sources:

1. Food and Nutrition Board, Institute of Medicine: *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids*. Washington, DC: National Academy Press, 2000 <books.nap.edu/catalog/9810.html>
2. Food and Nutrition Board, Institute of Medicine: *Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride*. Washington, DC: National Academy Press, 1997 <books.nap.edu/catalog/5776.html>
3. Food and Nutrition Board, Institute of Medicine: *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc.* Washington, DC: National Academy Press, 2001 <books.nap.edu/catalog/10026.html>
4. Food and Nutrition Board, Institute of Medicine: *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline*. Washington, DC: National Academy Press, 1998 <books.nap.edu/catalog/6015.html>
5. Teran FC, McCullough AF: Nutrition in liver diseases. In Gottschlich MM (ed): *The Science and Practice of Nutrition Support: A Case-Based Core Curriculum*. American Society for Parenteral and Enteral Nutrition. Dubuque, Iowa: Kendall/Hunt Publishing Company. 2001:537–552

Chapter 4: Assessment of Nutritional Status

- Evaluate the patient's nutritional status before intervention is initiated, and revisit throughout the course of care. Use a variety of assessment tools, as each has its specific purpose, strengths and weaknesses.
- Consider using a subjective global nutrition assessment tool that includes weight changes, appetite, satiety level, taste changes, diet history and gastrointestinal symptoms to assess patients with chronic liver disease. It is often more useful than standard measures.
- In developing a nutrition care plan, consider:
  - existence of HIV coinfection or other medical conditions associated with nutritional issues
  - feasibility of nutritional repletion
  - patient prognosis and desire for well-being
  - the medical treatment plan
  - the health care setting in which the nutrition care will be provided (i.e. outpatient clinic, long-term care or residence, home care or acute care)
  - circumstances in the home that may have an impact on implementation of recommendations
- Assist the patient and others supporting patient care to establish realistic and individualized goals to meet the nutrition needs identified. Specific counselling recommendations should address the following areas as appropriate for the individual patient:
  - healthy eating principles to ensure adequate nutrient intake (*See Chapters 2 and 3.*)
  - a healthy eating plan, including examples of recommended foods and amounts *(See Resources for Chapters 2 and 3.*)
  - food skills, including food shopping, storage, safety, preparation and dining away from home (*See Chapter 8.*)
  - perinatal nutrition and breastfeeding issues for HCV-infected mothers of newborn children (*See Chapter 1.*)
  - nutrition strategies for management of disease symptoms or treatment side effects such as fatigue, anorexia, early satiety, nausea and vomiting, diarrhea, food intolerances and other barriers to food intake (*See Chapter 5.*)
  - psychosocial and economic issues that may prevent appropriate nutrient intake; referral and access to community resources that help to support nutrition and health (*See Chapter 7.*)
  - alternative feeding methods (supplementation, enteral, parenteral)
  - additional therapies that support nutrition including physical activity and exercise, and medications for symptom management and disease management (*See Chapter 2.*)
  - guidelines for the evaluation of nutrition information and claims for individual vitamin and mineral supplementation, and other complementary and alternative medical/nutrition practices (*See Chapter 6.*)
- Refer patients at high nutritional risk to a registered dietitian for individualized assessment and monitoring. See the Practice Essentials for *Chapter 3* for advice on when to refer.

Chapter 5: Dealing with Symptoms and Treatment Side Effects

- Always ask patients if they are suffering from significant discomforts (either related to disease symptoms or treatment side effects) and take immediate action to help them manage the condition through dietary modifications, lifestyle changes and, if necessary, approved medications. See suggestions in *Appendix F.*
- Track and assess the patient's lifestyle and activity level to determine which actions are helping. Promote self-care and self-awareness by having the patient document fatigue patterns, rest, nutrition, exercise and activity levels.
- Promote the need for good nutrition, adequate rest and regular physical activity (within the person's tolerance). Proper nutrition and light to moderate physical activity can often help alleviate the discomforts. The emphasis should be on nutrient-dense foods. Encourage patients to keep themselves well hydrated. See *Chapter 2* and tips in *Appendices C* and *F*.

Nausea and Vomiting

- Patients on antiviral treatment frequently experience anorexia, nausea and vomiting. Allow the severity of the nausea and vomiting to dictate the course of action.
- Inform the patient that nausea is sometimes made worse by an empty stomach, kitchen odours, fried or spicy foods, increased fatigue or stress, not having enough fluids or the smell of cigarettes. Offer the tips in *Appendix F*.
- Those with severe nausea and vomiting are at risk of dehydration, electrolyte imbalances, abnormal metabolism and weight loss. Emphasize eating foods that are well tolerated. Those on treatment experiencing any of these problems should receive individualized advice from a registered dietitian at their hospital or treatment centre.
- Advise the patient to consult a doctor and/or dietitian if nausea or vomiting persists more than a few days or is severe.

Chapter 6: Complementary and Alternative Therapies

- Be informed about complementary and alternative (CAM) therapies commonly used by persons infected with HCV, such as vitamin/mineral supplements and herbal products; understand patient concerns and be partners in their care. Know about the rationale for use as well as the safety and effectiveness of the products. (*See References and Resources for Chapter 6.)*
- Always make safety the first concern. No herbal, diet supplement or alternative medicines have been proven to cure or even relieve symptoms of hepatitis C. At this point, consider all such treatments experimental.
- As part of the nutrition assessment, determine the type and amount of herbal preparations and supplements used, the extent to which these replace nutrition intake, the risk of interactions or potential toxicities with conventional antiviral treatment, and the risk of damage to the compromised liver. Routinely ask patients in a non-confrontational way about their use of CAM therapies. Use open-ended, non-judgemental questions, such as "Which herbal products do you use?" If possible, examine the supplement labels to determine the contents and dose, and then ask the patient how often and for how long he or she has been consuming the supplement. Encourage open discussion so patients will be comfortable asking questions about these therapies.

Vitamin / Mineral Supplements

- Ask about use of or interest in vitamin and mineral supplements. Emphasize the benefits of a healthy diet and food sources of antioxidants (*see list in Appendix B*). Review the recommendations for supplementation in *Chapter 3*.
- Be prepared to offer feedback, advice and recommendations concerning the appropriate use and safety of dietary supplements based on current Dietary Reference Intake (DRI) recommendations. The content of supplements is not restricted to levels that adhere to safe Upper Limits (ULs). Base recommendations on knowledge of product content and the new RDAs, AIs and ULs, and when and how they apply. Information concerning Canadian nutritive supplements is accessible on Health Canada's Drug Products website. (*See general Resources.*)

Herbal Products

- Because the evidence is so limited, the only way to reduce the risk of liver damage is to limit the use of herbal products, and to be aware of the herbs that are known to be toxic to the liver and thus can do more harm than good (*see list in Chapter 6*). Remind patients that a product called "all-natural" is not necessarily safe or harmless.
- Inform patients interested in taking herbal supplements that these products are not currently regulated in the same stringent manner as prescription drugs. Ingredients can vary from lot to lot, and it is not advisable to take a mixture of several herbs.

Chapter 7: Nutritionally At-Risk Groups

Concomitant Medical Conditions

- Understand the presence of co-existing medical conditions and their potential confounding impact on the progression of hepatitis C and the nutritional status of the patient.
- Refer hepatitis C patients with concurrent HIV, diabetes or renal disease to a registered dietitian for individualized assessment and counselling.
- Keep up-to-date with guidelines for nutrition care of persons with such co-existing medical conditions. (*See appropriate sections in Chapter 7.*)

At-Risk Population or Lifestyle Groups

- Develop cultural and linguistic competency. Consider language, cultural background, cognitive function and literary skills of the patient and care provider in any counselling or educational materials.
- Recognize and help persons with HCV who use alcohol and other substances, or who live in poverty and/or with violence. Use sensitivity in discussing their circumstances.

Children and Adolescents

- Because of the increased risk for growth failure and developmental delay, refer children for full nutrition evaluation as soon as possible after diagnosis of hepatitis C. It has also been recommended that children with chronic liver disease undergo periodic nutritional assessment.
- Recognize and be able to overcome challenges to intervention with children and adolescents. Children with undisclosed diagnoses or older children who are realizing a lifetime of association with a stigmatizing disease may rebel against taking medications and adhering to healthy eating principles or specific dietary restrictions.
- For informed adolescents (when disclosure of the diagnosis has been permitted by the parent or legal guardian), develop a comfortable rapport that shows respect for the teenager as an individual. This will help establish positive approaches to increase compliance with medication and dietary guidelines.

Aboriginal Peoples

- Health care providers can advise Aboriginal people with hepatitis C about nutrition more effectively if they understand the customs, beliefs, communication patterns and learning styles, and the general circumstances of this and other cultural groups.
- Consult Aboriginal health programs in the community.
- Consult Aboriginal food guides (*see Resources for Chapter 7*).

Alcohol and Substance Use

- Adopt a non-judgemental attitude with those who may be using alcohol (*also see Chapter 2*) or other substances.
- Recommend alcohol avoidance. In the absence of scientific evidence for a safe intake level, a prudent recommendation is for the person with HCV to abstain from alcohol use.
- Inform patients that, although the mechanism is not completely worked out, it is clear that alcohol acts synergistically with HCV to damage the liver, and may impair the body's immune defence against the virus.
- Identify drinking and drug use patterns with screening procedures, such as self-administered questionnaires, interviews and clinical judgement. Routinely ask patients in a non-confrontational way about their use of alcohol. Use open-ended, non-judgemental questions, such as "How many drinks do you consume in a day/week/month?" The Healthy Eating Checklist (*Appendix A*) includes questions related to substance use.
- For patients who drink heavily (regularly consume >2 standard drinks in a day, or regularly have <2 alcohol-free days per week), recommend a reduction in alcohol intake as the first step in any attempt to reduce the possible risk of serious liver damage. This is also an important step before considering treatment options.
- Conduct a brief intervention with those who have a non-dependent substance use disorder: provide counselling with a view to changing maladaptive substance use behaviours. Remind those who continue to drink or use other substances once they know they are infected with HCV that stopping at any time will benefit the health of their liver. For those who cannot abstain, offer the following tips for reducing alcohol intake.

Tips for Reducing Alcohol Intake

- Finish each drink before the next to keep track of how many you have had.
- Avoid binge drinking (drinking a lot in a short time).
- Try low alcohol drinks.
- Alternate non-alcoholic drinks with alcoholic ones.
- Avoid places where there may be pressure to drink heavily.
- Avoid drinking in "rounds" by buying your own drinks.

- Controlling alcohol intake may be difficult for some patients, especially if it is central to their social life or if there is alcohol dependence. Refer those with a dependent substance use disorder to an addiction specialist or an appropriate treatment program with due consideration of problem severity, cultural background, overall health status and level of social stability.
- Consult information on nutrition care for individuals undergoing treatment for chemical dependency, including dietary suggestions that have proven useful for treating the symptoms associated with withdrawal. (*See References for Chapter 7.)*

Poverty

- Ask those who may not be eating adequately because of economic circumstances:
  - Do you sometimes not have enough money to buy food?
  - (If yes), How often has this happened in the past month?
- Help patients with HCV receive the support they need to nourish themselves and their families. Be aware of community services and programs for nutritionally vulnerable patients. Contact your local public health office or community health centre for more information.

Violence

- Ask those who may be at risk of violence questions such as:
  - Do you feel safe with the person you are living with?
  - Do you feel safe in the neighbourhood you are living in?
  - Do you have someone to talk to about things that are happening in your life?
- Identify possible victims of violence during medical visits or when they seek emergency health care. Refer those who may be at risk of poor nutritional outcome because of violence to appropriate services.
- Become familiar with local support services such as transition houses, police services, distress centres, sexual assault centres and other social service programs available for those living with violence.

Chapter 8: Skills for Healthy Eating

Shopping and Food Budgeting

- Be aware that the person infected with HCV may not have a lot of money to buy food, may not know how to cook and may have limited energy.
- Ask your patients if they ever run out of money to buy food. If so, ask how often this has happened in the past month. Help them think of ways to eat better for less money.
- Refer patients at risk for malnutrition based on psychosocial or economic status to social service professionals for more complete evaluation and intervention.
- Review the planning and shopping tips and low-cost nutritious choices (*see Appendices G and H*). If patients commonly use more expensive convenience foods, help them think of ways to make them more nutritious, by adding nutritious foods to them.
- Help patients understand how to use nutrition labelling to help increase or decrease their intake of particular nutrients, compare products more easily and determine the nutritional value of foods. (See *Appendix I* and the education Resources for *Chapter 8*.)
- Remind patients that healthy eating is a priority and that they can eat well with some planning. Provide patients with tips for planning ahead: setting a budget, planning meals and shopping carefully (*see Appendices G and H).* Counselling by a registered dietitian may be appropriate.

Food Safety

- Counsel patients with HCV about safe food-handling practices. Explain that the best way to avoid food poisoning is to store and prepare foods safely, especially by washing hands often and well when handling food and when cooking.
- Remind patients that you cannot tell if a food is safe to eat by its look, smell or taste. Offer the tips for proper food-handling practices in *Appendix J.*
- When flu-like symptoms are present, consider all possible causes, including food-borne illness.

Introduction

These guidelines have been developed to give health care providers consistent, science-based nutrition-related information for counselling persons infected with the hepatitis C virus (HCV). This resource will help health care providers:

- meet the nutritional requirements of persons infected with HCV — at various stages of the disease process — through better nutrition and healthy lifestyle practices
- identify persons infected with HCV who may be at risk of poor nutritional status and poor disease outcome
- consult specific resources that can improve the nutritional health of those at risk

The benefits of having nationally recognized nutrition guidelines include:

- nutrition-related information to support those infected with and affected by HCV
- better control or slowing of the disease progression
- improved quality of life for those affected

Target Audience for the Guidelines

These guidelines are directed to a wide range of health care providers — including physicians, nurses, registered dietitians and public health nutritionists, pharmacists, educators, fitness professionals and other health intermediaries — who are in a position to offer nutrition-related advice and guidance to persons infected with HCV.

Rationale for the Guidelines

Hepatitis C is a communicable liver disease caused by HCV. It is progressive, with up to 85% of persons exposed to HCV developing chronic liver disease over a 10- to 40-year period.[1,2] HCV infection is one of the leading causes of chronic liver disease, and its prevalence is growing. Worldwide, there are an estimated 170 million HCV carriers;[1,3,4] the prevalence in Canada is estimated to be about 0.8% (240,000 persons).[3] Liver disease related to HCV infection is the leading reason for liver transplantation in Canada[3] and the United States.[1,2]

HCV was initially identified in 1989. Many factors appear to influence the rate of disease progression. Nutrition may play an important role in this process, although the degree has not been well established. However, the liver is the primary metabolic organ, orchestrating a complex array of biochemical and physiological processes linked to nutrition. Because of its direct role in nutrition processes, damage to the liver will have an important impact on nutritional intake and overall nutritional status in persons infected with HCV. Based on the known general benefits of nutrition, it is evident that nutritional health will help persons with HCV infection feel stronger and improve their quality and enjoyment of life.[5–8] Malnutrition commonly occurs with progressive liver disease and has been found to have a significant negative impact on morbidity and mortality in this population.[9,10,11]

Results of Needs Assessment

A needs assessment study conducted in 2000 by Dietitians of Canada, commissioned by Health Canada, confirmed the need for appropriate national nutrition guidelines. It comprised a literature review on existing nutritional guidelines and other information and knowledge relating to nutrition for persons infected with HCV,[12] as well as interviews with health professionals, professional and consumer associations and persons infected with or affected by HCV.[13]

- The review of scientific literature did not locate any guidelines on nutritional requirements specific to patients with hepatitis C, or to patients with mild to moderate hepatic disease activity.
- The persons infected with HCV who were interviewed indicated that they value nutrition, convinced that what they eat and drink makes a difference to their quality of life. In seeking nutrition information from physicians, associations and support groups, and the Internet, they indicated limited success and a lack of consistency in the information. They wanted information about how food affects the liver, nutrition advice for the different stages of the disease, simple recipes with suggested menus, information on holistic medicine, herbal products and antioxidants, and information on dealing with specific problems associated with hepatitis C and the role of nutrition in concomitant medical conditions.

- The consumer associations interviewed indicated that almost every incoming call from persons infected with HCV includes a question related to nutrition.
- The health professionals interviewed stressed the importance of clinical evidence to support the role of nutrition. They wanted information on the different stages of the disease, complementary and alternative therapies that may be commonly used by persons with HCV, as well as on managing the side effects of medications and on medication's effect upon dietary intake.

How the Guidelines Were Developed

Health Canada, Community Acquired Infections Division, awarded funding to Dietitians of Canada to develop these guidelines and supporting patient education material. The guidelines also form the basis of an online professional education component.

- The guidelines and patient handouts were developed with the technical support of a national advisory committee of representatives from organizations working to improve the quality of life for persons infected with HCV: Canadian Association for the Study of the Liver, Canadian Association of Hepatology Nurses, Canadian Hemophilia Society, Canadian Liver Foundation, Dietitians of Canada, Health Canada – Community Acquired Infections Division, and Hepatitis C Society of Canada.
- The guidelines were also reviewed by health professionals practising in this area, including a working group of registered dietitians, and endorsed by the participating organizations. The patient handouts have been tested through focus groups with persons infected with HCV.
- The process generally followed the *Proposed Framework for Dietetic Practice Guidelines* developed by Dietitians of Canada. *(For this and other key guidelines consulted for advice on developing the framework, see the Resources section for this chapter.)*

Scientific Evidence

These guidelines are designed to provide information to assist decision making and are based on the best information available at the time of publication. Wherever possible, the guidelines are based on scientific evidence.

- They are founded on the extensive literature review conducted as part of the needs assessment,[12] as well as a thorough search to locate new scientific evidence.
- In general, the following types of documents, listed in descending order of priority, shaped the guidelines: current federal government standards and policy statements, consensus reports, peer-reviewed literature reviews, peer-reviewed primary research, non-peer reviewed literature reviews, and non-peer reviewed primary research.
- In the absence of scientific evidence, best-accepted practice is presented.
- The document is not designed to be an all-encompassing practical guide. However, Practice Essentials are outlined, including tips and advice for health care providers based on scientific evidence and accepted practice.

Population Health Perspective

In this document, health and nutrition for persons infected with HCV are addressed from a population health perspective. This approach recognizes that health is determined not solely by health care and personal health choices, but also by other social, economic and physical factors. These determinants of health include gender, social support networks, coping skills, employment, physical and social environments, culture, income, social status, access to adequate housing and education, and freedom from violence. The availability of foods and an individual's capacity to make choices are greatly influenced by the determinants of health, as recognized in *Nutrition for Health: An Agenda for Action*, the current plan of action for nutrition in Canada.[14]

Specialized programs may offer support, nutritional counselling, education and referrals. They should be identified locally and referrals made to them when appropriate *(for key organizations involved in hepatitis C, see Resources)*. Other supports that may be relevant in certain circumstances include social services and addiction treatment.

For more information, consult…
- **References** for this chapter
- **Resources** for this chapter

Chapter 1 — A Primer on Hepatitis C

Description of the Issue

Characterized in 1989, the hepatitis C virus (HCV) is one of the leading known causes of chronic liver disease (40% attributed).[1,2] Chronic HCV infection is a progressive disease that gradually advances over 10 to 40 years. Up to 85% of persons exposed to HCV develop chronic liver disease.[3,4] It has been called a silent epidemic as it often progresses without symptoms until significant damage has occurred. Because most persons with undiagnosed chronic HCV infection are likely to come to medical attention in the next decade, a four-fold increase in the number of adults diagnosed with the infection is projected from 1990 to 2015.[5]

HCV is a leading cause of cirrhosis, a common cause of hepatocellular carcinoma (HCC) and the leading cause of liver transplantation.[2–4] Many HCV infected persons are in the 30 to 39 age group[5] and may become affected by complications of the disease over the next 10 to 20 years. Simulation analysis predicts a dramatic increase in hepatitis C-related cirrhosis (92%), liver failure (126%), HCC (102%) and liver-related death (126%) in Canada between 1998 and 2008.[6]

Hepatitis C: A Major Health Care Problem Worldwide

Prevalance is growing; currently between 1% and 4%[1,7]

- 170 million infected worldwide[2–4,8]
- 4 million in the US[3], about 3 million chronic[1,9]; 35,000 new cases annually[3,9]
- **240,000 in Canada** (estimated 0.8%)[2,5,10]; 5,000 new cases annually[5]

Who Is at Risk

HCV is particularly good at mutating and no vaccine exists. It is spread primarily by blood-to-blood contact. The following are some of the major risk factors for contracting HCV:[2,3,5,7,9,11–15]

- blood transfusions before 1992 (approximately 10% of existing cases)
- frequent exposure to blood products (such as patients with hemophilia), organ transplants, chronic renal failure, cancer requiring chemotherapy
- injection drug use (sharing needles and other drug-related equipment such as syringes, swabs, filters, spoons, tourniquets) (about two thirds of new HCV infections every year)[5,15,16]
- getting a tattoo or having body piercing or acupuncture where operator uses unclean equipment
- vertical (maternal–infant) transmission (5% to 10% risk)[14,17]
- needle stick injuries among health care workers (4% to 10% risk)[17]
- high-risk sexual behaviour and sharing straws for intranasal cocaine use[9,18]

Hemophilia patients who received clotting factor concentrates before the availability of heat-treated factors in the mid-1980s were almost universally infected with HCV.[19] Although the risk is low, hepatitis C may be spread by sharing household articles, such as a razor or toothbrush, with an infected person if blood is present. Risk of transmission between long-term monogamous sexual partners is minimal. As many as 20% of infected patients have no identifiable risk factor.[14]

Pregnancy and Breastfeeding

The reported estimated risk for mother-to-infant transmission of HCV infection has varied widely, ranging from 0% to 10%. The risk may be higher if the mother is coinfected with HIV.[3] A recent review article reports a risk of 5% in a large prospective analysis that defined transmission as persistent viremia in infants 1 year of age.[14]

Breastfeeding does not appear to transmit HCV.[3] In theory, infection could be possible if the disease is active and aggressive, the mother has cracked nipples that bleed and the baby has a cut in the mouth. However, to date no cases of transmission of the virus through breastfeeding have been documented.

Children and Adolescents

Compared to adults, knowledge of HCV infection in children is limited. This is because there are many fewer children than adults infected with HCV,[5] and children are less likely to have symptoms from their HCV infection. (*See also Chapter 7.*)

Diagnosis of HCV

Even when biochemical and pathological evidence confirm the disease, many individuals may not have overt symptoms of liver disease.[1,2,7,9,11–13] If symptoms are present, they are generally mild and intermittent, the most common being fatigue. A small proportion of patients may experience muscle and joint pains, nausea, vomiting and poor appetite.[12,13] The urine may become dark brown. In severe infections, jaundice may be apparent. However, the presence or absence of any of these symptoms is not indicative of the degree of liver damage. Many of the symptoms are not specific to HCV infection and may be experienced by people with other chronic health problems. Irreversible hepatic failure develops late in the disease.[12,13] *(Managing discomforts related to the disease, see Chapter 5.)*

Population screening has not been recommended. Chronic hepatitis C is diagnosed primarily by serology in those presenting with risk factors. For initial testing, enzyme immunoassay (EIA) is used to detect antibodies to HCV. Because of false positive reactions, supplemental tests are needed, such as recombinant immunoblot assay (RIBA). The "gold standard" is quantitative detection of viral load (HCV-RNA) using gene amplification techniques (e.g. PCR).

The key laboratory parameters evaluated in presenting patients include:[3,7,12,13]

- liver enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (AST): persistent elevation in ALT suggests active liver disease
- CBC (complete blood cell count)
- liver function tests (bilirubin; albumin; prothrombin time – International Normalized Ratio or INR)
- anti-viral test (EIA – enzyme immunoassay; RIBA – recombinant immunoblot assay)
- HCV-RNA test (detection, quantification of viral load, and genotyping)

Current Treatment Strategies

The goal of anti-viral treatment is to prevent further progression of liver disease. Until the latter half of 2002, the combination of interferon alpha 2B and ribavirin was the treatment of choice. Now, the slow-release, longer acting interferon alpha (pegylated formulation) in combination with ribavirin is available.[3] This latter treatment has demonstrated slightly (5% to 10%) better response rates than previous treatments, with a sustained virological response between 50% and 60%.[20–23] Combination therapy is poorly tolerated in decompensated cirrhosis and in recurrent hepatitis C after liver transplantation and response rates are low.[24] Ribavirin is teratogenic and can induce hemolytic anemia; it is contraindicated for patients with pre-existing anemia, bone marrow suppression or renal failure.[25] *(Managing side effects of treatment, see Chapter 5.)*

How HCV Affects the Liver

Unlike the HIV/AIDS virus, HCV does not attack the immune system. Rather, it causes a localized inflammatory reaction that involves the entire liver.[1,3,7,12,13] The localized nature of the reaction allows the virus to gradually infect and destroy liver tissue, so liver damage progresses slowly and subtle nutritional deficits are not obvious at early stages of the disease.[1,3,7,12,13]

Stages of Liver Disease

Acute Hepatitis

- Approximately 15% to 25% of persons infected with HCV appear to resolve their infection.[25]

Individual hepatocytes have focal necrosis, and regenerate without fibrous scar formation.[12,13] Persons with acute HCV infection typically are either asymptomatic or have a mild clinical illness: 60% to 70% have no discernible symptoms, 20% to 30% might have jaundice; and 10% to 20% might have non-specific symptoms such as anorexia, malaise or abdominal pain.[25]

Chronic Hepatitis

- About 75% to 85% of persons infected with HCV progress to chronic infection. The course is generally slow, without symptoms for two or more decades after infection.[2,3,5,7,9]

Chronic HCV infection involves inflammation that persists beyond 6 months. Mild intermittent symptoms may be present, or no symptoms at all. The course and outcome of chronic HCV varies considerably. In some individuals, spontaneous remission occurs over a few years. In others, the disease is more severe and progressive; sustained inflammation results in extensive hepatic necrosis, leading to the development of cirrhosis and eventual end-stage liver disease.[12,13,26] Chronic HCV infection can lead to liver damage, fibrosis, steatosis, cirrhosis and liver cancer. Generally, liver failure occurs only when about 80% of the liver mass is lost; in these severe cases, the only possible treatment is liver transplant.

Cirrhosis

- Estimates of the proportion of chronically HCV-infected persons who develop cirrhosis after 20 years vary widely.[2,7,9,11,16,27–29] The actual risk is likely about 10% to 15%.[3]
- Most of those with cirrhosis have **compensated** disease and exhibit few or no symptoms.[16]
- Of those with cirrhosis, the probability of **decompensation** is 25% after 10 years. Once a patient develops decompensated cirrhosis, the death rate (without transplantation) is 50% after 5 years.[16]

Despite the liver's tremendous capacity for regeneration, repeated insults followed by repair can cause fibrosis and irreversible scarring (cirrhosis). Extensive scarring prevents blood flow through the liver, causing more hepatocyte death and a loss of liver function. Cirrhosis causes an increase in hepatic vascular resistance, which eventually leads to portal hypertension and ascites.[12,13]

Liver Cancer

- Of those with cirrhosis, it is estimated that 0% to 3% per year develop primary hepatocellular carcinoma (HCC).[3] About 5% to 10% of infected persons ultimately will develop HCC.[2,3,7,9,11,14]

HCV accounts for an estimated one third of HCC cases in the US.[3] The frequent cycles of liver cell injury and repair may result in alterations in the cells' genetic material that can predispose the liver to cancer. In the US (and likely Canada), deaths associated with chronic hepatitis C are more likely to be due to decompensated cirrhosis than to HCC.[3]

Liver Transplant

- Liver transplantation is indicated in those with hepatitis C who develop liver failure. Liver disease related to HCV infection is the leading reason for liver transplantation in Canada[2] and the US.[3,4]

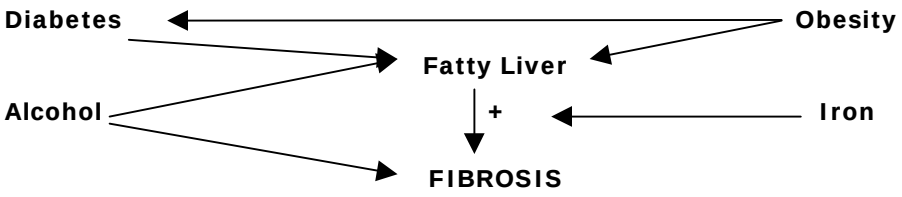
The overall success rate of the surgery is high. Although in almost all cases the transplanted liver becomes infected with HCV, it can continue to function well for many years.

Factors Implicated in Progression of Liver Damage

There is little evidence that virologic factors, including viral load, viral genotype and quasi-species diversity, significantly affect the risk of progression of liver disease. However, many host factors increase this risk. Patients with no apparent active disease at diagnosis generally have the most favourable prognosis over a 20-year period. Risk factors for rapidly progressive disease include:[3,12,13]

- male gender
- age >40 years at time of infection
- daily alcohol consumption of >50 g/day (3–4 drinks)
- obesity
- associated medical conditions such as alcoholic liver disease, hepatitis B viral infection
- immunosuppression, particularly coinfection with HIV
- persistent elevation in serum ALT concentration
- active cirrhosis on liver biopsy

Potential Impact of Factors on the Progression of Hepatitis C



(*Alcohol, obesity and fatty liver, see Chapter 2. Diabetes, see Chapter 7. Iron, see Chapter 3.)*

The Role of the Liver in Nutrition

The Liver's Metabolic Role

The liver is a vital part of the digestive system—the body's "chemical refinery and power plant". It is the primary metabolic organ, orchestrating a complex array of biochemical and physiological processes linked to nutrition. The liver is strategically positioned between the portal and systemic circulation to enable its key role in metabolism and detoxification within the body.[30,31] Located beneath the diaphragm in the upper right part of the abdomen, the liver is the largest organ in the body. Virtually all blood returning from the intestinal tract to the heart passes through the liver. Most of the end products of digestion are transported directly to the liver.

The liver significantly influences nutritional status through its role in the intermediary metabolism of the macronutrients protein, carbohydrate and lipids, as well as micronutrients and bile salts.[27,29,30–34] The main functions of the liver are:

- synthesis of blood proteins (e.g. albumin, transferrin, prealbumin, prothrombin)
- secretion of bile (required for digestion and absorption of fat)
- metabolism of toxins (alcohol, drugs, bilirubin, ammonia)
- control of the traffic of nutrients between body compartments during fasting and fed states

Normal Metabolism of Macronutrients

- **Protein** synthesis and degradation occur in the liver.[30,31] Ingested proteins are broken down into amino acids in the intestine and delivered to the liver for use in synthesizing body proteins. The liver maintains a reserve to replenish serum proteins as needed. Certain proteins are converted into ammonia, which is detoxified by the liver through conversion to urea for excretion in the urine; the carbon residues are turned into fatty acids or glucose for energy or eventual storage. Hormones such as insulin, glucagon and glucocorticoids, as well as nutritional status, influence protein synthesis by the liver.[29–31,34]
- **Carbohydrate** metabolism is regulated through the synthesis, storage and breakdown of glycogen within the liver.[30,31] Carbohydrates are absorbed through the lining of the intestine and transported to the liver, where they are turned into glycogen and stored. Glycogen is readily mobilized to provide glucose to the body. Key enzymes and hormones such as epinephrine, insulin and glucagon are an important part of carbohydrate metabolism regulated through this organ.[30]
- **Fat** is synthesized, stored and exported by the liver. The liver produces bile, making it possible for dietary fat, as well as the fat-soluble vitamins A, D, E and K, to be absorbed in the small intestine. After digestion, bile acids are reabsorbed by the intestine, returned to the liver, and recycled as bile. When carbohydrate intake exceeds energy requirements, glycogen storage within the liver is probably exceeded and triglyceride synthesis is then stimulated. Triglycerides are incorporated into lipoproteins for transport to adipose tissue for storage.[29–31]

Normal Metabolism of Micronutrients

- Most of the body's **iron** is stored in the liver (as ferritin) until needed. **Copper** is also stored in the liver and is necessary for the production of hemoglobin. Iron is an integral part of hemoglobin, and **vitamin B_{12}** (also stored in the liver) brings about the maturation and release of red blood cells in the bone marrow. The iron from discarded red blood cells is recovered and stored by the liver.[12,13]
- All of the **fat-soluble vitamins** are stored in the liver: considerable amounts of vitamins A, D and K, and small amounts of vitamin E. The liver converts carotene into vitamin A, vitamin K into prothrombin, and vitamin D into an active form ($25(OH)D_3$). It also stores appreciable amounts of **vitamin C** and the **B-complex** vitamins.[12,13]

How HCV Affects Nutritional Status

The degree to which nutritional factors contribute to the progression of liver disease has not been well established. However, the liver is the primary metabolic organ of the body that coordinates biochemical and physiological processes directly linked with nutrient intake. As a result, changes in the functional status of the liver will have an impact on nutritional intake and overall nutritional status.

Given the central role of the liver in metabolism, it is not surprising that undernutrition is common in chronic liver disease. Malnutrition commonly occurs with progressive liver disease and has been found to have a significant negative impact on morbidity and mortality in persons infected with HCV.[32–34] Malnutrition is not only a complication of liver disease but can also perpetuate the disease. In addition, the anorexia, nausea and vomiting associated with liver disease can lead to poor dietary intake and further potential for malnutrition. Patients with decompensated cirrhosis are often malnourished, with wasting of the muscle mass and an emaciated appearance.

Liver failure does not become obvious until most of the hepatocytes have been destroyed, at which point it becomes difficult for the body to maintain nutritional homeostasis, use nutrients appropriately, synthesize plasma proteins and detoxify noxious substances.[30,31]

For more information, consult…
- **Practice Essentials** for this chapter
- **References** for this chapter
- **Resources** for this chapter

Chapter 2 – Healthy Lifestyle Overview

An important opportunity exists to reach persons infected with HCV with a positive message about the benefits of a healthy lifestyle. They express a high level of interest in nutrition—as a factor over which they can have some control.[1–3]

Proven Benefits of Nutrition

Healthy eating is a significant factor in reducing the risk of developing a variety of chronic conditions.[4,5] Good nutrition improves physical capacity and functioning, tissue repair and wound healing, and helps to maintain normal fluid and electrolyte balances. Poor nutritional status is related to compromised immunity; deficiencies and sometimes excesses of nutrients adversely affect immune and other normal body processes.[6]

Healthy Eating for Persons Infected with HCV

Many factors appear to influence the rate of progression of hepatitis C. An appropriate diet is part of the overall treatment that can make hepatitis C manageable. It may aid the liver in regeneration of liver cells damaged by HCV and help the patient cope with symptoms of the disease. It may enhance the response to treatment and lessen its side effects.[7,8] *(Coping with discomforts and treatment side effects, see Chapter 5.)*

Maintaining or adopting a healthy eating pattern provides benefits that go beyond immediate well-being to ensure a better health status later in life[4,5] and potentially slow the progression of HCV infection.[8] Because the disease progresses slowly, subtle nutritional deficits are not always obvious at early stages. Therefore, it is vitally important that patients infected with HCV try to maintain a balanced diet with adequate energy, protein, carbohydrate, fat, vitamins, minerals and fluids. Eating well can become more of a challenge as liver disease progresses.

Healthy Eating Guidelines in Canada

Canada's Guidelines for Healthy Eating (CGHE) and *Canada's Food Guide to Healthy Eating* (CFGHE) are the two basic tools to promote healthy eating, and are based on nutrition and food science research.[4] CGHE summarizes the principles of healthy eating in five general statements: enjoy a variety of foods; emphasize cereals, breads, other grain products, vegetables and fruit; choose lower fat dairy products, leaner meats, and foods prepared with little or no fat; achieve and maintain a healthy body weight by enjoying regular physical activity and healthy eating; and limit salt, alcohol and caffeine.

CFGHE provides more detailed information to guide people in the selection of all foods for a healthy eating pattern that provides all the nutrients required for good health. It organizes foods into four food groups and the "Other Foods" category. Eating less than the minimum number of servings, which provides about 1800 kcal, can result in higher risk of nutrient deficiencies. (See *Appendix B*.)

There is no single "diet for liver disease". Although geared for a healthy population, CGHE and CFGHE are generally appropriate as a starting point for persons infected with HCV. Nutrient-rich choices that include whole grains, vegetables and fruit are a priority. Persons with hepatitis C do not need to follow specific dietary restrictions unless they have advanced liver disease or some other condition such as diabetes or celiac disease that requires dietary modification (*see Chapters 3 and 7).*

A healthy diet for persons infected with HCV includes:

- a variety of foods from all four food groups of *Canada's Food Guide to Healthy Eating*
- adequate but not excessive energy intake, spread out over the day
- adequate protein intake for fighting infection and for liver regeneration
- plenty of fruits and vegetables to maximize free radical-fighting antioxidants (emphasize variety and colour)
- foods that are rich in vitamin A and vitamin C
- avoidance of alcohol to protect the liver and allow it to regenerate
- limited high fat and high sugar foods
- food intake balanced with some activity, within physical limitations

(*Healthy Eating Checklist to assess general diet quality, see Appendix A. Summary of food guide principles and list of food sources of antioxidants, see Appendix B. Skills for healthy eating, see Chapter 8.*)

Those who follow a vegetarian style of eating should consume a wide variety of plant foods.[9] In the vegan diet, energy, iron, calcium, zinc, vitamin D, vitamin B_{12} and omega-3 fatty acids may require special attention. Daily food guides for vegetarians are available (*see Resources for this chapter*). Following a strict exclusion diet of any kind is unnecessary and may result in dietary deficiencies. Fad diets for weight reduction should be avoided.[10,11] (*See "Importance of a Healthy Body Weight" later in this chapter*.)

Alcohol and Hepatitis C

For persons with HCV infection, strong arguments exist on the basis of epidemiology, virology, histology and carcinogenesis to advise against alcohol consumption, regardless of the degree of liver injury.[12] Not all sources are clear on the need to abstain completely, and it is not certain that the occasional intake of small amounts of alcohol does significant damage;[12,13] however, in some persons even modest amounts of alcohol may accelerate disease progression.[13] Studies are needed to assess whether there are safe levels of alcohol consumption in patients with hepatitis C and the effect of higher levels of alcohol use on disease progression.[13] In the absence of scientific evidence for a safe intake level, a prudent recommendation is for the person with HCV infection to avoid alcohol.

- There is strong evidence that alcohol use is an important cofactor in the progression of HCV liver disease to cirrhosis and HCC.[14–18] Alcohol also contributes to fatty liver, and is an independent risk factor for fibrosis. Higher levels of alcohol use promote progression of liver disease, with strong evidence for detrimental effects of 30 g/day in men (approximately 2 beer, 2 glasses of wine or 2 mixed drinks) and 20 g/day in women.[13] The risk of developing cirrhosis and HCC appears to be higher for persons with hepatitis C if they also drink heavily.[13,19–21] Lower amounts of alcohol may also increase the risk of liver damage associated with HCV.[13]
- Damage from alcohol may obscure the results of liver function tests, making it unclear whether a change in test indicates damage to the liver due to the disease or the alcohol.
- Alcohol may exacerbate side effects associated with current anti-viral treatment and impair the body's immune defence against the virus.[17] Significantly better treatment outcomes have been reported among abstainers than among drinkers; non-response to interferon therapy was found among 10.7% of abstainers and 63.1% of drinkers (mean alcohol consumption >40 g/day).[22]
- Alcohol adds to energy intake and may suppress appetite and displace nutrient-dense foods. Alcohol also can lead to micronutrient deficiencies: nutrient availability is affected by decreased food intake, increased need for nutrients to detoxify alcohol and heal the liver and other organs, impaired absorption, inactivation of vitamins and coenzymes required to metabolize energy, inadequate nutrient storage in the damaged liver, and other factors.[23]

(Alcohol and substance use as a determinant of health, see Chapter 7.)

Importance of a Healthy Body Weight

A healthy body weight promotes general health and reduces the incidence of disease.[5,24] It can fall within a range of weights for any given height that is compatible with good health.[‡] Because weight-related problems can adversely affect health, patients with chronic HCV should be advised to achieve and maintain a healthy weight by adopting healthy eating and activity patterns. The particular weight challenge in hepatitis C will vary from person to person and can vary for any given individual at different stages of the disease. Obesity potentially accelerates fibrogenic capacity of HCV; thus weight management or reduction may be appropriate for some. Others, for example in advanced disease, may face the challenge of unintentional weight loss and wasting. (*Body weight, Body Mass Index and alternative anthropometric measures, see Chapter 4.*)

Maintaining a Healthy Weight

CGHE is a useful tool for all Canadians, including persons with HCV, to achieve and maintain a healthy body weight. In instances of low body weight, unintentional weight loss or wasting, more specific nutrition intervention may be required. *(Prevention and treatment of malnutrition, see Chapter 3. Coping strategies for symptoms related to the disease or treatment side effects, see Chapter 5).*

Risks of Overweight

Steatosis occurs in more than 50% of patients with chronic hepatitis C. In many of these patients, the pathogenesis appears to be related to obesity,[7,10,25–29] and possibly visceral adiposity,[10,30] rather than

[‡] Health Canada is updating the weight classification system that has been in use in Canada since 1988. The guidelines will reflect current scientific information on specify body weights associated with optimal health and with risks to health. See <www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/weights_e.html>.

intensity of alcohol use.[27] Hepatic steatosis, especially when associated with obesity, is an important precursor to the development of fibrosis in hepatitis C and other liver diseases.[28,29]

Weight reduction may provide an important adjunct treatment strategy for patients with chronic hepatitis C. In overweight patients with steatosis who subsequently lose weight, liver-related abnormalities improve.[25] Although sustained weight loss may be difficult to achieve, weight loss in these patients may be associated with a reduction in steatosis and abnormal liver enzymes and an improvement in fibrosis, despite the persistence of the virus.[25,26,29] Weight loss has also been shown to decrease visceral fat.[10] However, rapid weight loss may actually worsen liver injury, causing portal inflammation and fibrosis.[10,11] Thus gradual weight loss of 10% of body weight should be the goal,[7] through healthy eating and regular physical activity, not through fad diets.

Importance of Physical Activity

Canada's Physical Activity Guide to Healthy Active Living recommends that Canadians accumulate 30 to 60 minutes of physical activity every day to stay healthy or improve their health.[31] To prevent unwanted weight gain as well as to accrue additional weight-independent health benefits of physical activity, 60 minutes of daily moderate intensity physical activity (e.g. walking/jogging at 6.5–8 km/h) is recommended, in addition to the activities required by a sedentary lifestyle.[5] However, many Canadians are not achieving that goal,[32,33] particularly women[32] and older Canadians.[33]

A healthy lifestyle includes regular physical activity. Moderate exercise is recommended for all persons with hepatitis C who are not experiencing decompensated cirrhosis or other metabolic complications. Physical activity will not affect the course of infection, but regular exercise can help relieve symptoms of tiredness, stress and depression, improve appetite,[34,35] build up the immune system and improve sense of well-being.[5,34,36] Research suggests that moderate activity may enhance immune function, whereas exhaustive exercise may result in immune suppression.[37] Moderate activity can improve circulation, helping nutrients and fluids reach body cells, and improve lean body mass.

Adults are more likely to remain active if they engage in activities that they feel competent doing, find enjoyable, can easily access and fit into their daily schedules and that they feel yield a net benefit.[38] Persons with HCV infection should be advised to exercise to their tolerance. The most common advice is to do low-impact exercise, such as walking and swimming, and slowly increase activities until the recommended level is achieved. Patients who were previously sedentary should be made aware that they may unconsciously compensate for added periods of mild to moderate intensity exercise by reducing other activities.[5] *(Summary of types of physical activity, examples and general safety tips, see Appendix C.)*

For more information, consult…

- **Practice Essentials** for this chapter
- **References** for this chapter
- **Resources** for this chapter
- **Appendices A, B, C**

Chapter 3 – Nutrition Intervention in Hepatitis C

The overall purpose of nutrition care for persons infected with HCV is to promote optimal nutrition and prevent or treat malnutrition or deficiencies in specific nutrients. A detailed review of the literature[1] indicated no articles pertaining specifically to hepatitis C and nutritional requirements or protein–energy malnutrition (PEM). However, several key resources provide guidelines related to nutrition and liver disease.[2–8] Where specific recommendations were not consistent, more weight was given to more recent resources as well as accepted practice. This chapter provides an overview of nutrient guidelines for hepatitis C, as well as considerations for nutrition intervention in various stages of the disease.

Guidelines for Nutrition Intervention in Hepatitis C

Nutrition therapy should be individualized. In general, persons infected with HCV do not need to follow specific dietary restrictions, unless they have advanced liver disease or some other condition such as diabetes or celiac disease that requires dietary modification. In those cases, adjustments in macronutrients, electrolytes, fluids, vitamins and minerals may be indicated. Alcohol has specifically been identified as having a deleterious effect on HCV-associated liver disease, so patients are typically advised against its use.[9,10] (*See Chapter 2*).

Oral nutrition management is appropriate for patients with hepatitis and for those with cirrhosis. Nutrition support (enteral and/or parenteral delivery of nutrients) is indicated for patients with severe liver disease who cannot meet their nutrition needs through oral intake. Nutrition guidelines in the various stages of HCV infection are summarized in the tables in the *Practice Essentials* section and outlined in more detail in this chapter.

Goals of Nutrition Intervention in Hepatitis C

The following are the general goals of nutrition intervention in liver disease.[2,4–6,11,12] Their relative importance depends on the stage of disease.

- to provide adequate energy and protein to facilitate hepatocyte regeneration, which will improve liver metabolism and overall nutritional status
- to promote and maintain nitrogen balance, avoiding excess production of ammonia from endogenous or exogenous protein catabolism
- to avoid complications related to the role of the liver in intermediary metabolism of carbohydrate, lipids and protein
- to provide adequate vitamins and minerals
- to avoid fluid and electrolyte imbalance
- to use appropriate supplementation when needed
- to treat or reduce symptoms or treatment side effects *(See Chapter 5.)*
- to prevent increased morbidity or death related to nutritional factors

Nutrient Guidelines Overview[2 ϕ]

Energy

Measured energy expenditure may vary considerably among patients with hepatitis C[13] and among those with severe liver disease.[14] However, on average, energy requirements are higher in persons with cirrhosis,[15] which contributes to the weight loss observed in 60% of this group.[5,16,17] Hypermetabolism may be observed in up to one third of cirrhotic patients.[18] Measured energy needs of patients with HCV infection, even in the absence of cirrhosis, are on average higher per unit of lean body mass than the needs of healthy individuals.[13] These increased energy needs appear to be higher with higher HCV viral loads.[13] Patients with acute hepatitis may have higher energy requirements

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ϕ Canada and the US are reviewing scientific data and releasing expanded nutrient recommendations. These new Dietary Reference Intakes (DRIs) consist of four categories of reference values: Estimated Average Requirement (EAR), Recommended Dietary Allowance (RDA), Adequate Intake (AI) and Tolerable Upper Intake Level (UL). For macronutrients, Acceptable Macronutrient Distribution Ranges (AMDR) have been established for individuals (expressed as % of total energy intake). The DRIs for most nutrients have been established and are beginning to be implemented into education programs and nutritional assessment.

More information on the DRI process, and tables providing the RDA, AI and UL for age- and gender-specific categories: <search.nap.edu/nap-cgi/naptitle.cgi?Search=dietary+reference+intakes>
Background information on the DRI process: <www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/diet_ref_e.html>

compared to those with compensated cirrhosis to facilitate liver regeneration.[19] A high-energy diet is normally recommended for HCV-infected persons.[11,20,21] Results of a prospective study suggest that evaluation of energy metabolism can be used to predict survival in patients with viral liver cirrhosis.[22]

Indirect calorimetry is recommended to assess energy needs most accurately. If it is not available, the following provides two reasonable estimates of energy needs for patients undergoing physiological stress, such as those with infection:

- 25 to 40 kcal/kg, based on dry weight or an adjusted ideal weight[2,4,5,8,19] or
- add 20% to 40% to basal energy expenditure (BEE) using the Harris–Benedict equation.[3,15,23–25]

In malnourished patients, energy needs are 1.5 to 1.75 X BEE or 35 to 45 kcal/kg.[3]

Factors such as obesity, stability of infection, need for repletion, presence of ascites, malnutrition or other disease conditions should also be considered when estimating energy needs (*see table in Practice Essentials*). For example, in the presence of ascites, an additional 10% should be added.[5,18]

Energy requirement for the healthy population is defined as the amount of energy that needs to be consumed by individuals to sustain stable body weights in the range desired for good health (BMI 18.5–25) while maintaining lifestyles that include adequate levels of physical activity.[26] The Estimated Energy Requirement (EER) is defined as the average dietary energy intake that is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height and level of physical activity, consistent with good health.[26]

Protein

Adequate protein intake is important to build and maintain muscle mass and to assist in healing and repair. Protein intake must be adjusted for body weight and medical condition. The Acceptable Macronutrient Distribution Range (AMDR) for protein is estimated to be 10% to 35% of total energy intake for healthy adults; the RDA for healthy adults is 0.8 g/kg/day based on meta-analysis of nitrogen balance studies.[26] Patients with cirrhosis tend to be hypermetabolic, and a higher than normal supply of dietary proteins is needed to achieve nitrogen balance;[27] the requirement in hepatitis C is estimated minimally at 1.0 to 1.2 g/kg/day and may range up to 1.5 g/kg.[2–5,25,28,29] (*For a quick protein check calculation and a list of the protein content of some common foods, see Appendix D.*)

More than 95% of patients with cirrhosis can tolerate a diet containing up to 1.5 g/kg/day of protein, without risk of hepatic encephalopathy (HE).[4,5,27,30–32] In those with cirrhosis, a modified eating pattern, based on several meals and a late evening snack, is useful for promoting nitrogen balance.[27] In severely malnourished patients, protein–energy supplements may be considered to meet protein requirements.[27]

In general, dietary protein is limited only in patients with acute HE or refractory HE not attributable to another cause such as gastrointestinal bleeding, infection, dehydration, lactulose non-compliance, or constipation.[15] Protein restriction, which was formerly believed to prevent HE or progression of liver dysfunction, can result in the breakdown of endogenous protein and further malnutrition in the patient with liver disease. A restriction of less than 0.5 g protein/kg/day may result in endogenous protein breakdown and further nutritional decline.[15]

Protein Source

Some controversy exists over the type of protein a diet for liver disease should contain. Vegetable (e.g. beans, lentils, tofu) and dairy protein may be better tolerated than non-dairy animal protein foods.[33] A small but well-conducted study showed that vegetable protein may be better tolerated than animal protein by those with HE.[34]

Branched-chain amino acids

Whereas certain aromatic amino acids (tyrosine, phenylalanine, tryptophan) are metabolized in the liver, branched-chain amino acids (BCAA: valine, leucine, isoleucine) are metabolized in peripheral muscle and thus do not overload the liver.

Although controlled trials are lacking, there is some evidence that BCAA may be useful in select cirrhotic patients with chronic HE who cannot tolerate the recommended intake of standard protein.[28,29,35–39] Long-term supplementation with BCAA has been associated with improved liver function and nitrogen accretion in protein-intolerant patients.[40,41]

Use of BCAA nutritional formulas should be considered case by case. Experts agree that many patients with liver disease can tolerate standard amino acid supplements.[5,23,24,29,30,39] BCAA-enriched formulas are recommended only in cases with severe encephalopathy and negative nitrogen balance with standard amino acids at a dose of 0.6 to 0.8 g/kg/day.[27] The use of high-BCAA may be beneficial in attempting to improve the nitrogen balance of severely protein-intolerant patients who have not responded to aggressive medical treatment of HE.[5,23,24,40] BCAA can be used to keep the acute HE patient in positive nitrogen balance when the individual is in a comatose state and is not improving, and the cause of HE cannot be found. NutriHep©, a ready-to-use, high-caloric–density nutrition supplement containing 50% BCAA, is currently being used in some liver centres for oral and enteral feeding. *(More information on HE is provided later in this chapter.)*

Carbohydrates

Impaired carbohydrate metabolism brought about by alterations in liver glucose production and storage may decrease glucose tolerance. In cirrhotic patients, a decrease in glucose oxidation along with an increase in lipid oxidation has been observed, which is independent of nutritional status.[6,42,43] A higher prevalence of diabetes mellitus is seen among persons infected with HCV, and chronic hepatitis C may contribute to the development of diabetes: impaired glucose tolerance with accompanying insulin resistance and hyperinsulinemia occurs commonly in cirrhotic patients,[6,31,32,44] with about 20% developing diabetes mellitus.[45,46]

Chronic hyperinsulinemia may cause insulin resistance in cirrhosis, possibly due to diminished hepatic insulin degradation, which would be the primary metabolic defect in cirrhosis.[47] Patients in liver failure are often hyperinsulinemic, which can increase somatic protein catabolism and decrease blood glucose levels. These patients also have decreased ability to synthesize glycogen. Taken together, these alterations in carbohydrate metabolism can make serum glucose levels quite labile, resulting in hyper- or hypoglycemia. Serum glucose should be monitored carefully, and elevated blood sugar levels controlled with exogenous insulin. Restriction of intravenous carbohydrate or dietary sugars is generally not indicated, as carbohydrates are essential to provide adequate energy.[2]

It is important to note that reductions in carbohydrate intake could be mediated by hyperinsulinemia, and compounded by preferential uptake of carbohydrate. This may enhance gastrointestinal satiety signalling and contribute to hypophagia.[48]

The AMDR for carbohydrate is estimated to be 45% to 65% of total energy intake for adults.[26] An RDA for carbohydrate is set at 130 g/day for adults and children. Although insufficient data exist to set a UL for added sugars, a maximal intake level of 25% or less of energy is suggested to prevent the displacement of foods that are major sources of essential micronutrients.[26]

Fibre

An AI for total fibre is set at 38 g/day for men and 25 g/day for women aged 19 to 50 years.[26] Requirements for hepatitis C would not likely differ.

Lipids

Fat intake is not routinely restricted in liver disease, as the liver is able to metabolize fats and manufacture bile for fat digestion even when it is seriously damaged.[2] In the fasting state, plasma free fatty acids as well as glycerol and ketone bodies are increased.[6] However, plasma clearance is normal in cirrhosis,[49] suggesting that the net capacity to store exogenous lipid does not seem to be impaired even in cirrhotic patients.[6] Results of a case–control study suggest an association between higher lipid intake and increased risk for cirrhosis in persons infected with HCV.[50] However, there is no clinical research confirming an indication for routine restriction of fat intake in chronic HCV infection.

The AMDR for fat is estimated to be 20% to 35% of total energy intake for adults.[26] For n-6 PUFAs, the AMDR is 5% to 10% of energy, which is expected to meet the AI for linoleic acid (17 g/day for young men and 12 g/day for young women). The AMDR for alpha-linolenic acid is 0.6% to 1.2% of energy, with up to 10% of the AMDR consumed as eicosapentaenoic acid (EPA) and/or docosahexaenoic acid (DHA); the AI is 1.6 g/day for men and 1.1 g/day for women.

For most persons with hepatitis C, the dietary fat intake advocated in CFGHE is appropriate. As with the general population, it is recommended that consumption of saturated fatty acids, trans fatty acids and cholesterol be as low as possible while consuming a nutritionally adequate diet.[26]

Steatorrhea

Steatorrhea, or severe fat malabsorption, due to reduced synthesis and secretion of bile acids, is reported in 40% of persons with cirrhosis from all causes;[5] however, the actual extent in HCV-related cirrhosis is unknown. Fat intolerance may potentially occur with reduced or obstructed bile flow, some drug treatments or alcohol-related gastrointestinal tract abnormalities. Dietary fat may need to be restricted if steatorrhea is documented by fecal fat collection.

Medium-chain triglycerides (MCTs) may be used to supplement the diet if malabsorption occurs,[5] as they are directly and rapidly absorbed into portal circulation and their absorption does not depend on entry into the lymphatic system.

- MCT supplements (such as MCT Oil® and Portagen®) may be used. MCT Oil® can be added to fruit juices, salads, fat-free salad dressings, and vegetables, or incorporated into sauce recipes for lean meats, chicken and fish. MCT Oil® can also be used like other oils in cooking and baking, in main dishes, or other recipes, as the fat replacement. Portagen® is a milk-based powder supplement (essentially lactose-free) that also contains protein, carbohydrate, vitamins and minerals and can be used to make beverages, shakes, soups, sauces, and other recipes such as pancakes, waffles and French toast. Other liquid-based supplements (semi-elemental or elemental, such as Peptamen®) also contain MCT oil along with other nutrients that are easily absorbed and digested for those at risk for malabsorption. The manufacturers can provide recipes and indications for use.
- MCT products should be introduced slowly to avoid unpleasant side effects, including nausea, vomiting and diarrhea. A divided dose of 1 Tbsp 3 to 4 times/day is usually well tolerated. Guidelines for food selection for a long-chain triglyceride (LCT)-restricted, MCT diet are available.[51]
- MCT oil does not provide essential fatty acids (EFA); therefore care should be taken to provide at least 3% of total energy intake as linoleic acid. This requirement can be met by adding up to 10 g (0.7 Tbsp) daily of vegetable seed oils (corn, sunflower, safflower, or margarine blended with vegetable oils).[51]

Patients with steatorrhea >10 g/day may also have difficulty absorbing fat-soluble vitamins,[5] whereas water-soluble vitamins are absorbed normally. Water-soluble forms of fat-soluble vitamins are available by prescription *(see section on fat-soluble vitamins)*.

Polyunsaturated Fats

Decreased polyunsaturated fatty acids (PUFA) have been found in cirrhotic patients, correlating to nutritional status[52] and the severity of liver disease.[53] The PUFA content of erythrocyte membranes in cirrhotic patients may be decreased compared to healthy controls, with a more pronounced effect noted in patients with alcoholic cirrhosis compared to those whose disease is viral in origin.[54] A study in two regions of Japan using a quantitative food frequency questionnaire suggests that habitual food intake affects the plasma fatty acid profile and that elevated serum ALT may be related to arachidonic acid deficiency and vulnerability to lipid peroxidation in cirrhotic patients with hepatitis B or hepatitis C viruses.[55] However, it is not clear whether and how much PUFA to supplement in patients with hepatitis C. Although some PUFA are necessary for health, they are potent precursors of free radicals, which increase oxidative stress,[56] in a population of patients already identified as being under oxidative stress.[57,58] Further studies need to be undertaken to determine whether increased fat intake should be encouraged in this population, using PUFA as an important source of EFA.

Fluids

The source of the common advice for healthy persons to consume at least 8 cups/day of water has been called into question in a recent review, and rigorous proof found to be lacking.[59] However, it remains a practical way of providing general advice to the public. More specifically, in the healthy population, fluid requirements are commonly estimated as:[60]

- urine output plus 500 mL/day
- 1 mL/kcal
- 35 or 30 mL/kg/day in adults 20 to 55 and 55 to 75 years of age, respectively

Requirements are higher in those with fever, vomiting or diarrhea.

The need for fluids is governed by thirst and can be met by emphasizing water, milk and fruit juice, with addition of milkshakes and liquid nutrition supplements when additional energy and protein intake is required.

Fluid restriction may be necessary if ascites is present. Patients with persistent, significant hyponatremia (serum sodium <120 mmol/L) after sodium restriction and diuretic adjustment may need fluid restriction, [61,62] usually limited to 1.0 to 1.5 L/day.[3] Intake and output records, daily weights and electrolyte values are necessary for monitoring fluid status. A concentrated enteral or parenteral formula may be used as needed.

Electrolytes

Serum electrolyte levels should be monitored carefully and supplemented as needed.

Sodium

Sodium restriction may be necessary to alleviate fluid retention associated with ascites or peripheral edema. Dietary sodium restriction is important as sodium intake can otherwise override the effects of diuretics. Before diet instruction is provided, a history of usual eating patterns should be evaluated. People who have a very compromised intake may not require a less palatable sodium-restricted diet to stay within an acceptable sodium intake.

- Generally, no more than 2000 mg/day (87 mmol/day) of sodium should be ingested to minimize water retention and facilitate blood pressure control.
- In severe cases of ascites, further restriction may be necessary (1000–2000 mg/day, or 44–87 mmol/day).[2] However, severe dietary sodium restriction is less palatable and may contribute to decreased oral intake and diet non-compliance.
- If a more stringent sodium restriction is required (500–1000 mg/day), a controlled setting such as hospitalization may be required.
- A 24-hour urine sodium record is the recommended means to monitor compliance with sodium-restricted diets.
- In addition to avoiding salty foods, salt in cooking and salt at the table, it is necessary to select low-sodium foods. Most fresh foods are low in sodium. Lemon juice and herb/spice mixtures that do not contain sodium may be suggested as salt substitutes.
- Many prepared foods contain large amounts of sodium. Food labels are an important source of information on sodium content; the patient should be taught how to evaluate food labels and identify foods high and low in sodium. *(Nutrition labelling, see Chapter 8.)*
- Restaurant meals, especially fast-food outlets, and convenience meals tend to be high in sodium. Information should be provided to patients who will be eating meals away from home.

(Sodium-restricted diet, see reference 63. Guidelines for food selection with sodium restriction, see Appendix E.)

Potassium

Potassium replacement needs to be considered to prevent hypokalemia when renal function is adequate and potassium-wasting diuretics are used. If potassium intake from foods is insufficient to replace losses, supplements may be necessary.[63]

Vitamins

Not much research is available on vitamin needs specific to patients with hepatitis C. However, it is known that vitamin deficiencies are common in patients with cirrhosis, especially if it is alcohol-induced. Vitamin deficiency is also common in alcoholism.[5]

Fat-soluble Vitamins

Normal production of bile is essential for the digestion and absorption of fat and fat-soluble vitamins (A,D,E,K). The incidence of fat malabsorption in HCV-induced cirrhosis is unknown.

- Presence of fat malabsorption can be measured by fecal fat collection. Fat-soluble vitamin supplementation is recommended if steatorrhea is >10 g/day.[5] Water-soluble forms are available (e.g. ADEKS). Use of a detergent-like solution of vitamin E (TPGS – tocopherol polyethylene glycol solution) improves the absorption of vitamin E in patients with advanced liver disease. The same solution may also improve absorption of vitamins A, D and K if taken simultaneously.
- Serum vitamin D can be monitored as cirrhosis progresses and supplemented if deficiency is detected. As the liver activates vitamin D, a fully activated form (Rocaltrol®) may be preferable in advanced disease, particularly for transplant candidates.

Vitamin A

Some evidence suggests that vitamin A may play a role in prevention of HCC. Serum retinol and total hepatic vitamin A stores are lower in cirrhotic patients than in controls. Serum vitamin A levels are also lower among persons with cirrhosis and HCC than among persons who are healthy, who have hepatitis C, or who have cirrhosis without HCC.[64] However, because serum retinol levels do not correlate with hepatic vitamin A levels, the decision to prescribe vitamin A replacement for patients with cirrhosis should not be made solely on the basis of serum retinol levels.[65]

Whereas vitamin A deficiency may increase the risk of HCC, excess vitamin A is hepatotoxic. The toxicity of vitamin A (retinol) is enhanced by ethanol; they share some metabolic pathways and may therefore be in competition for metabolism. A US study demonstrated that some individuals with damaged livers who consumed alcohol experienced vitamin-A induced hepatotoxicity when they took supplements in doses within therapeutic dose limits.[66]

No published studies to date have reported on beta-carotene supplements and outcomes of hepatitis. There also have been no reports of vitamin A toxicity from plant food sources of the vitamin. An optimal and safe intake of vitamin A for hepatitis C is unknown. The RDAs for healthy females and males are 2300 IU and 3000 IU, respectively. The UL is 3000 mcg (10,000 IU).[67] Routine supplementation above the level found in a multivitamin is discouraged.

Vitamin C

One small study reported low serum vitamin C (ascorbate) levels in persons with hepatitis C and porphyria cutanea tarda (PCT). Persons with hepatitis C without PCT had normal vitamin C levels; the authors speculated that vitamin C deficiency may be one of the factors contributing to PCT.[68] The strong pro-oxidant nature of the iron–ascorbate complex in vitro raises concerns that consumption of high-dose vitamin C supplements by individuals with high iron stores may contribute to oxidative damage in vivo.[69] This concern could extend to persons with hepatitis C, as high iron stores are commonly noted in this patient group.

An optimal and safe intake of vitamin C for persons with hepatitis C is unknown. The RDAs for healthy females and males are 75 mg and 90 mg, respectively. The UL for healthy persons is 2000 mg,[69] but no research confirms that this UL is also safe in hepatitis C.

Vitamin E

Whether vitamin E has a role in supportive therapy for hepatitis C is not yet clear. Larger studies are needed to confirm early evidence that supports the benefit of supplementation as antioxidant therapy. A small study showed improvement in liver function tests of people taking 800 IU/day vitamin E for 3 months.[70] Vitamin E also shows promise for therapy of muscle cramps in patients with cirrhosis based on a study of 13 patients treated with 200 mg vitamin E, 3 times/day for 4 weeks.[71] Daily dosages up to 1000 mg are generally considered safe for a healthy adult.[26] The blood-thinning effect at high dosages needs to be considered, especially in people with bleeding tendency.

Thiamine

Very early evidence suggests that thiamine may have antiviral properties. It has been shown to reduce HIV production in vitro,[72] and has been proposed to slow or reverse liver injury by reduction of iron load.[73] Three crossover case studies related to hepatitis B reported that thiamine supplementation (100 mg/day as thiamine hydrochloride for 3–4 years) was linked with a reduction in ALT and a fall of hepatitis B virus DNA to undetectable levels;[74] larger trials will be needed to test the effect of thiamine on reducing liver damage or inducing remission of the hepatitis B virus. Authors of a prospective study suggest that thiamine should be given to patients with cirrhosis irrespective of its cause.[75] Whereas none of the patients with chronic hepatitis C without cirrhosis was deficient in thiamine, the range of thiamine deficiency was similar among those with alcohol- or HCV-related cirrhosis.[75]

An optimal and safe intake of thiamine for hepatitis C is unknown. The RDAs for healthy females and males are 1.1 g and 1.2 g, respectively. There have been no apparent reports of toxicity from excess consumption of thiamine from supplements, and no UL has been set.

Niacin

Hepatic toxicities have been reported with unmodified and, in particular, time-release niacin preparations.[76] Most of the reports mentioned in the review were above 1 g/day but one was as low as 500 mg/day for 2 months. An awareness of this toxicity is important because of the widespread availability and potential for self-prescribed, unmonitored use.

Vitamins B_6, B_{12} and Folate

Recent studies have found elevated homocysteine to be a characteristic of liver cirrhosis. This raises several questions that remain unanswered: is impaired liver function a new factor in the development of elevated homocysteine, does elevated homocysteine have a role in the development of liver fibrosis,[77] and what effect, if any, would administration of vitamins B_6, B_{12} or folate have in slowing liver fibrosis?

In a recent study,[78] 98 liver transplant patients with elevated homocysteine were supplemented with 1 mg/day of folic acid for 4 weeks; those with continued high levels were given 4 mg/day folic acid plus vitamins B_6 and B_{12} for an additional 4 weeks, with further mean decreases in homocysteine. Another study indicated that 10 mg of folate supplemented for 3 months resulted in a decrease in fasting serum homocysteine in 9 of the 10 liver transplant patients studied.[79] Hyperhomocysteinemia was associated with hepatitis C in univariate but not multivariate analysis.[79]

Minerals

Trace elements should be supplemented when they are recognized as being deficient. Excess copper and manganese should be avoided in patients with biliary obstruction, as these are normally excreted in bile. Iron therapy may be contraindicated in some situations, as outlined below. Patients with cirrhosis may exhibit deficiencies in calcium, magnesium and zinc.

Iron

The liver is the primary storage organ for iron. A significant proportion of patients with chronic HCV has a moderate increase in hepatic iron content;[80] hepatic iron content is usually normal or only mildly elevated in the absence of cirrhosis.[81] Iron within the liver has been implicated as a precursor to liver injury in patients with chronic HCV.[82] Elevations in serum transferrin-iron saturation and ferritin are common in patients with chronic HCV infection, especially if they have concomitant elevations in serum AST and ALT. However, serum markers of iron stores do not accurately reflect hepatic iron content, or predict clinically important endpoints such as response to interferon and disease progression.[81]

Liver Injury – Iron depletion by phlebotomy consistently reduces serum AST and ALT;[83–85] iron removal may be beneficial for patients with chronic active hepatitis C and histochemical iron in the liver.[86] Iron likely contributes to liver injury by promoting lipid peroxidation. A relationship is reported between hepatic iron and increased hepatic inflammation in both hepatitis B and hepatitis C patients,[87] and also between hepatic iron content and liver fibrosis,[88] with high fibrosis scores in hepatitis C.[87] Further study using an animal model has indicated that HCV infection increases the susceptibility of the liver to injury following iron loading.[89] More recently, studies in humans suggest that iron overload and HCV infection are independent risk factors for liver fibrosis progression, and their concomitant presence results in striking increase in risk.[90]

Response to Antiviral Treatment – Hepatic iron concentration is one of the strongest predictors of response to interferon monotherapy.[81] In combination with interferon, phlebotomy may improve antiviral efficacy compared to interferon alone,[81,91,92] although some studies have concluded otherwise.[84,85,93] Although further studies are needed, high hepatic iron concentrations do not appear to have an influence on virologic response rate to combination interferon–ribavirin therapy.[93] One study found that raised s-ferritin values predicate non-response to 6 months interferon–ribavirin therapy in hepatitis C patients.[94] No data are available on the role, if any, of iron depletion therapy as an adjunct to interferon–ribavirin combination treatment.[81]

Dietary Iron – An optimal and safe intake of iron for hepatitis C is unknown. The RDA for healthy adult males and for females 19 to 50 years of age is 18 mg; the RDA for females 51 or older is 8 mg. The UL is 45 mg.[67] Some results suggest that a low iron diet may be of benefit to some patients with hepatitis C. As indicated above, phlebotomy has been shown to reduce serum AST and ALT.[83–85] In addition, long-term iron reduction therapy in patients with chronic hepatitis C may potentially lower the risk of progression to HCC.[95] A low iron diet, tested in a culture where phlebotomy is not socially acceptable, resulted in significant reductions in serum iron and transferrin saturation index, irrespective of baseline iron levels.[96] Results of a clinical trial suggest that an iron-restricted diet may be an important therapy for improving liver injury in cirrhotic patients with chronic hepatitis C:[97] after 18 months of dietary iron restriction to <7 mg/day, mean serum ferritin and serum AST and ALT decreased significantly and serum unsaturated iron binding capacity level increased significantly.

Iron Supplementation – For those without elevated serum iron or cirrhosis, the amount of iron present in a multivitamin and mineral supplement is appropriate. Further supplementation is not generally recommended. Patients with chronic HCV whose serum iron is elevated, or who have cirrhosis, should choose a multivitamin without iron,[98] restrict their intake of iron-rich foods, such as red meats, liver and iron-fortified cereals, and avoid cooking with iron-coated cookware and utensils. Iron therapy should be withheld in patients with hemochromatosis or hemosiderosis, but may be indicated in patients with esophageal or gastrointestinal bleeding,[2] or patients with iron-deficiency anemia. The treatment should be continued for as short a period as possible.

Selenium

It is speculated that selenium may have a role in treatment of hepatitis C because it has a known antioxidant function, low selenium levels commonly seen in persons with HIV are even lower with HCV coinfection, and selenium supplementation may slow viral reproduction in HIV.[99] However, the long-term clinical and survival implications of selenium therapy are unknown. No studies yet confirm the theory that selenium may slow HCV reproduction.

An optimal and safe intake of selenium for hepatitis C is unknown. The RDAs for healthy adult females and males is 55 mcg.[69] Selenium is toxic at high intakes, with a UL of 400 mcg.

Zinc

The possibility that zinc might increase sustained virologic response has been proposed. A link between zinc deficiency and immune deficiency has been reported. Zinc inhibits replication of diverse viruses in vitro, including HIV. Whether zinc has an antiviral effect on HCV has also been studied recently. A small Japanese study showed improved response to interferon treatment with "polaprezinc" given at 150 mg/day (equivalent to 34 mg elemental zinc in chelated form).[100] No other studies yet confirm this finding.

Zinc deficiency is common in cirrhosis.[5,101] Cirrhotic patients with symptoms of zinc deficiency (e.g. altered taste or smell) could be tried on 3 months of supplementation with 220 mg zinc sulfate three times a day to see if their symptoms can be resolved. A study of 12 patients reported that zinc supplementation (oral zinc sulfate 220 mg twice daily for 12 weeks) may lead to improvement in symptoms associated with frequent muscle cramps in cirrhosis.[102]

Zinc is involved in altered nitrogen metabolism. There is some evidence that zinc deficiency might precipitate HE. A single study, although not randomized, supplemented with 600 mg/day zinc sulfate for 3 months with positive results, including improved hepatic nitrogen clearance and reduction in lipid peroxide levels.[101] A more recent study concluded that zinc deficiency in decompensated cirrhosis appears to be due to low absorption and to high urinary excretion, partly due to excessive diuretic administration, and that zinc supplementation might play an important role in the prevention of HE by activating glutamine synthetase.[103] Changes in the hormonal drive and/or the antioxidant activity of zinc might be involved in the general improvement in liver function, whereas the beneficial effects on HE might stem from decreased ammonia.

An optimal and safe intake of zinc for hepatitis C is unknown. The RDAs for healthy females and males are 8 mg and 11 mg, respectively.[67] Decreased immunity and copper deficiency have been reported with high intakes; the UL is 40 mg.

Calcium and Magnesium

Calcium deficiency may be related to poor vitamin D status, poor nutrition or malabsorption; correcting the underlying abnormality may restore calcium balance. Bone thinning may occur without these specific problems (*see section on hepatic bone disease*).

Magnesium deficiency may occur due to inadequate dietary intake, but develops most often in patients taking diuretics to treat fluid retention. Symptoms include muscle cramps, fatigue, weakness, nausea and vomiting. If the diuretics cannot be discontinued, a supplement of 500 mg magnesium gluconate three times a day may be considered. Diarrhea can be a side effect of magnesium supplementation.

Oxidative Stress

An increase in lipid peroxidation has been identified in patients with hepatitis C[104] and with hepatic cirrhosis,[105] along with decreased levels of potentially protective antioxidant enzymes[106] and antioxidant micronutrients.[107] These studies reinforce results of a pilot study that identified increased oxidative stress in patients with chronic hepatitis C.[108] A fibrogenesis cascade was stimulated with increased oxidative stress, and 8 weeks of high-dose vitamin E therapy (1200 IU/day of d-alpha-tocopherol) in six patients prevented the cascade and significantly decreased the carbonyl modifications of plasma proteins, a sensitive index of oxidative stress. However, treatment did not significantly affect serum ALT, HCV titers or histological degree of hepatocellular inflammation or fibrosis.[108] In one control study, patients with severe viral hepatitis were found to have significantly lower levels of plasma vitamin E and vitamin E:lipid ratios when compared to healthy subjects.[109] In a follow-up randomized double-blind cross-over design study, supplementation with high doses of vitamin E (2 X 400 IU RRR alpha-tocopherol/day) for 12 weeks had a positive effect on lowering elevated liver enzymes in 50% of the 23 subjects.[70] Because vitamin E is non-toxic even at elevated doses ingested over extended periods, the authors suggest the treatment of hepatitis C patients who are refractory to alpha-interferon treatment with vitamin E as a supportive therapy.[70]

Researchers report that antioxidant supplementation, specifically with vitamin C (1000 mg/day) and vitamin E (800 IU/day), delayed the onset of the anemia commonly seen with ribavirin treatment.[110] Another study demonstrated that hepatitis C patients taking high doses of vitamin E for 3 months had improved liver function tests.[110] However, some antioxidants such as vitamin C can be pro-oxidant under certain conditions, and systemically altering the redox state may have undesirable effects on the inflammatory response in certain disease states, particularly in conditions where there is a tendency to store iron.[111]

Oxidative stress appears to play a role in the pathogenesis of the hepatic injury. Nutritional antioxidants are attractive potential therapeutic and chemopreventive agents because they are inexpensive and have a relatively low toxicity profile. However, the evidence of their efficacy in hepatitis C remains unclear as long-term studies are lacking. At this time, antioxidant therapy (e.g. vitamin E, vitamin C, selenium) should be restricted to randomized, controlled clinical trials in which treatment effects can be closely monitored and therapeutic efficacy can be determined with scientific accuracy.[111]

Vitamin and Mineral Supplements

Illness can increase the body's requirements for vitamins and minerals. Vitamin supplements do not provide the diversity of beneficial substances found in foods and can come with the risk of exceeding the new ULs of safe intake—found among 47% of Canadian supplement users in the case of niacin.[112]

Multivitamin with Minerals

Foods are always first choice as a means of meeting nutritional requirements. A multivitamin with minerals can be useful to prevent potential deficiencies associated with poor intake, the metabolic disturbances of liver disease, and drug effects.[4,5] A multivitamin with minerals may be appropriate for those with hepatitis C,[5] particularly if appetite or food selection is poor.

Tips for Choosing a Multivitamin and Mineral Supplement

- Multivitamin/mineral containing some vitamin A, vitamin C, vitamin E, selenium and zinc, B-vitamins and folate
- Multivitamin/mineral with iron suitable for people without elevated iron stores or cirrhosis
- Multivitamin/mineral without iron if patient has high iron stores or cirrhosis (i.e. formula for men or adults over 50)

Individual Vitamin or Mineral Supplements

- Recommendations for the use of nutrient supplements to improve individual diets should come from physicians or registered dietitians applying current scientific knowledge after individual dietary and nutrition assessment. Vitamin and mineral supplementation for curative purposes should be done only under the supervision of a physician.[113]

- Supplements may be required in the following instances:[3,5,114]
  - HIV coinfection
  - excess alcohol intake – folic acid, vitamin B_{12}, thiamin
  - steatorrhea – fat-soluble vitamins in water-soluble form
  - hepatic bone disease – possibly calcium, liver-activated vitamin D (Rocaltrol®), magnesium, vitamin K *(see section)*
  - cirrhosis – vitamin K, zinc, magnesium, potassium, calcium *(see section)*
  - pre- and post-transplant *(see sections)*
- Use of any vitamin, mineral or herbal supplement should be carefully evaluated within the context of the patient's individual medical situation. *(Complementary and alternative therapies for HCV, see Chapter 6.)*
- Patients taking vitamin or mineral supplements should be warned not to exceed the recommended doses as excesses of some nutrients can be harmful.
- Excessive amounts of some vitamins may be an additional source of toxicity to the liver: vitamin A and vitamin D[115] or niacin.[76] These supplements should generally be avoided in amounts exceeding that found in a multivitamin.
- However, supplementation of fat-soluble vitamins A, D, E and K may be needed in water-soluble form if the patient has severe liver disease with fat malabsorption >10 g/day.
- Vitamin K injections may also be required in patients with severe liver disease showing clinical signs of deficiency.
- Antioxidant therapy (e.g. vitamin E, vitamin C, selenium) should be restricted to experimental conditions *(see previous section on oxidative stress)*. Because the safety of UL doses of vitamin C in hepatitis C has not been established, supplementation above the amount found in a multivitamin should not be encouraged.

Stage of Hepatitis C — Nutrition Considerations

Acute HCV Infection

During acute HCV infection, as in any acute liver disease, the goal is to provide adequate nutrition, considering energy, macronutrients and micronutrients, to enable the infected liver cells to regenerate.[2] For people with acute viral hepatitis who are relatively well, a general diet that follows CFGHE is recommended, choosing above the minimum number of servings. (*See table in Practice Essentials section.*) The diet should be nutritionally adequate if a suitable variety and quantity of foods are consumed. Healthy weights and moderate physical activity should be promoted. *(Healthy lifestyle, see Chapter 2.)* Severe anorexia, poor appetite, weight loss, nausea, vomiting or other symptoms of the disease or side effects of treatment can become a nutritional problem if they last longer than a few days; nutrition support is indicated as for any other illness. *(Strategies for coping with common symptoms and treatment side effects, see Chapter 5.)* In severe cases, progression to fulminant hepatic failure needs to be anticipated. Patients with profound or prolonged cholestasis require fat-soluble vitamin supplements.[5]

Chronic HCV Infection — early stages (pre-cirrhotic)

Many persons with chronic hepatitis C can eat a normal, well-balanced diet according to CFGHE and do not need specific dietary management. (*See table in Practice Essentials section.)* Healthy weights and moderate physical activity should be promoted in those with compensated disease. (*Healthy lifestyle, see Chapter 2.)* Symptoms and support are similar to those with acute HCV infection.

Chronic HCV Infection — cirrhosis

Cirrhosis may occur in about 10% to 15% of chronically HCV-infected patients.[9] Most of those with cirrhosis have compensated disease and exhibit few or no symptoms; nutrient needs are similar to those with acute HCV infection or pre-cirrhosis. In general, the patient with early stage or compensated cirrhosis still requires 25 to 40 kcal/kg/day.

As hepatitis C progresses, patients may experience loss of appetite, increasing fatigue and reduction in physical activity. Despite increased nutritional needs, eating becomes more of a challenge. *(Strategies for coping with common symptoms and treatment side effects, see Chapter 5.)*

Common Nutrition Problems in Decompensated Cirrhosis

- Malnutrition
- Maldigestion and malabsorption
- Hepatic encephalopathy (HE)
- Ascites
- Hepatic bone disease

Malnutrition

PEM impairs liver function but rarely causes morphological changes.[4,6] However, improved nutritional status of malnourished persons with cirrhosis improves liver function.[6] Malnutrition has a negative effect on clinical outcome of this population, considering survival and complications.[5,6] Some clinical studies suggest that malnutrition is an independent predictor of survival in patients with cirrhosis.[116]

The prevalence and severity of PEM are related to the clinical stage of chronic liver disease.[3–6,117,118] PEM is uncommon in pre-cirrhotic stages. Anthropometric evaluation indicates PEM in about 20% of patients with compensated liver cirrhosis and in about 60% of patients with severe liver failure.[6,119] More sensitive body composition measures suggest that the prevalence is likely higher.[6,120,121] Some researchers have suggested that malnutrition in end-stage liver disease (ESLD) is almost universal.[122]

Causes of Malnutrition in Cirrhosis [3–5,17,121,123,124]	
Metabolic abnormalities	-glucose intolerance -increased protein and lipid catabolism similar to sepsis, trauma or other catabolic states
Inadequate intake	-anorexia, nausea, vomiting -early satiety secondary to ascites -taste abnormalities -alcohol abuse -iatrogenic due to restrictive diets or NPO status, medications
Maldigestion and malabsorption	-fat maldigestion due to cholestasis or chronic pancreatitis -water-soluble vitamin malabsorption due to alcohol abuse -calcium- and lipid-soluble vitamin malabsorption due to cholestasis

NPO – nothing by mouth

Metabolic Abnormalities – The exact metabolic alterations responsible for malnutrition and its consequences in patients with chronic liver disease have been debated. Impairment of hepatic glycogen storage in cirrhotic patients effects a state of accelerated starvation with catabolism of fat and protein to provide substrates for gluconeogenesis. Hypermetabolism may be observed in up to one third of cirrhotic patients.[17] Disturbances in energy production and utilization, as well as macro- and micronutrient metabolism, have been appreciated but are not always easily identified or quantifiable. Manifestations of poor nutritional status can vary substantially among patients, even in those having the same etiology and severity of illness. Metabolic alterations can influence downregulation of appetite. In many instances, simple adjustments in diet can offset losses and stabilize or improve the patient's nutritional status.[122] Protein–energy supplements are also helpful in this patient group.

Inadequate Intake – This is likely one of the primary causes of nutritional deficiencies in patients with chronic liver disease.[125,126] A recent study indicates that the spontaneous dietary intake of cirrhotic patients was lower than that of controls, and lower than recommended intake levels.[127] Suboptimal nutrient intake might arise secondary to a number of factors *(see table)*. A high-energy, high-protein diet is recommended. This diet consists of small, frequent feedings of energy-dense and protein-dense foods, to provide at least 120% to 150% of the DRIs for energy and protein. *(High-calorie, high-protein diet, see reference 128. See table in Practice Essentials section.)* The actual amounts of energy and protein depend on the individual's height, weight, medical status and nutrition goals. *(See Chapter 4: Nutrition Assessment.)* Foods can be fortified with other energy-dense and/or protein-dense ingredients to increase energy and protein intake without increasing the volume of food. Oral protein–energy supplements may be helpful in conjunction with the usual diet. A multivitamin and mineral supplement is recommended when intake is inadequate.[5]

This frequent food intake pattern may be important when trying to maximize the dietary intake of subjects with cirrhosis.[129] Frequent small meals four to seven times per day, including an evening snack, have been found to improve nitrogen and substrate utilization in cirrhotic patients.[6,125,129,130] This modified pattern can also be used to address the early satiety and anorexia experienced by patients with ascites. It may assist as well in preventing the hypoglycemia and resultant catabolism of muscle associated with the hormonal derangements and diminished glycogen storage and mobilization capacity that occur in ESLD.[5,14,125,127]

Maldigestion and Malabsorption – A reduction in bile salt secretion and pool size has been reported in patients with advanced cirrhosis.[31,32] The smaller bile salt pool probably interferes with micelle formation and fat assimilation, ultimately increasing the risk of deficiencies of fat and fat-soluble vitamins.[31,32]

Cholestasis is an inability of the liver to secrete bile; bile cannot flow into the small intestine to aid in the digestion of fats. Although not common, this may result in severe fat malabsorption or steatorrhea, a condition usually associated with large amounts of pale-coloured and foul-smelling feces. Steatorrhea can be associated with weight loss due to lost food energy and can be quantified by fecal fat analysis. (*See Steatorrhea section earlier in chapter*).

Hepatic Encephalopathy

In a small but significant number of persons with cirrhosis, a complication known as hepatic encephalopathy (HE), or impaired mental function, may occur. Those affected may show signs of disorientation and confusion. The exact cause of HE is not fully understood, but may be caused by a buildup of protein breakdown products which the impaired liver is having trouble processing. The blood, which contains toxins, is "shunted", or redirected, back to the central circulation and into the brain without first going through the liver for detoxification. HE is often associated with a precipitating event, such as a gastrointestinal bleed, infection, fluid or electrolyte imbalances, or constipation. Excess protein intake is not a cause of HE in most patients. The cause should always be sought. Drug management can help maximize a person's protein tolerance. Those with chronic HE symptoms are often prescribed lactulose, which increases dietary protein tolerance by promoting defecation. Fluid status and electrolyte levels should be monitored carefully in patients receiving lactulose, and medication doses should be carefully titrated to induce the desired two to three daily soft bowel movements.[2]

Traditionally, HE has been treated with a low protein diet. However, prolonged low protein diets are no longer considered appropriate for chronic HE.[131–134] Low protein diets are also not suggested as a means of preventing HE in people who do not have symptoms. (*See Protein section earlier in chapter.)*

Ascites

Cirrhosis disturbs the regulation of body sodium and water. Excessive retention of sodium is the major driving force behind accumulation of fluid. Ascites, the accumulation of fluid in the abdominal cavity, is the most common of the major complications of cirrhosis.[61] Edema is the buildup of fluid in the tissues, usually the feet, legs or back.

Treatment for ascites can require dietary sodium restriction and often diuretics. Fluid intake restriction or fluid removal measures (e.g. paracentesis) are commonly implemented when serum sodium is <120 mmol/L.[61,62] Small, frequent meals seem to be better tolerated. Measures to remove fluid seem to improve food intake. The combination of abstinence from alcohol, a sodium-restricted diet and diuretics is effective in approximately 90% of patients.[61] (*See Fluids and Electrolytes sections earlier in chapter. See Practice Essentials section*.)

Hepatic Bone Disease

Decreased bone mass density can occur in viral-related chronic liver disease. The prevalence and degree worsen with deteriorating liver function. Osteoporosis is frequently found in patients with cholestatic liver disease; however, liver cirrhosis predisposes to bone loss regardless of the presence of cholestasis.[135] The underlying mechanism is probably related to decreased bone formation and increased bone resorption.[135,136] An increase in serum osteocalcin may also be due to the presence of vitamin K deficiency.[135] Hepatitis C-associated osteosclerosis has been reported in a very small number of cases, with the potential for a long latency period between HCV infection and the appearance of skeletal abnormalities.[137] As well, viral cirrhosis has been identified as a major cause of

high turnover osteoporosis in men, with low serum insulin-like growth factor (IGF-1) levels, believed to be associated with the loss in bone mass.[138]

The cause of hepatic bone disease is complex and involves more than nutrition-related factors. Deficiency in 25(OH)D_3 and low serum calcium levels are seen in only a small proportion of these patients. No nutrition support measures for hepatic bone disease have been documented. However, it is of particular concern for patients undergoing liver transplant, as transplant drugs exacerbate the problem of bone loss. Pre- and post-transplant therapy to reduce bone loss is recommended.[114]

Possible suggestions to avoid exacerbating the problem include:

- calcium 1500 mg from diet and therapeutic supplements
- vitamin D in multivitamin; screen for serum levels of 25(OH)D_3 and supplement with liver-activated form (Rocaltrol®) if levels low, especially in transplant candidates
- screen serum magnesium, especially in presence of deficiency symptoms; supplement if needed
- vitamin K injections if prolonged International Normalized Ratio (INR) or cholestatic liver disease

Calcium may be consumed in the form of milk products, calcium-fortified soy milk or supplements. When the patient cannot ingest enough calcium from the diet because of sodium or fluid restriction, supplements can be useful.

End-Stage Liver Disease, Liver Transplant

Although not all patients with end-stage liver disease (ESLD) are liver transplant candidates, transplant is the only treatment option. The purpose of nutrition care for liver transplant is to:[3]

- ameliorate the symptoms of ESLD, and to optimize pre-operative nutritional status
- provide appropriate nutrients postoperatively for promoting anabolism and wound healing
- prevent and treat postoperative complications
- manage the nutritional side effects of immunosuppressive and other drugs

Pre-Transplant Requirements[3]

Left untreated, the progressive wasting of liver disease leads to infection and increased risk of death owing to infection both before and after transplantation.[139] Proper nutritional therapy can improve clinical outcomes and well-being.[16,122,140] Some suggest aggressive nutrition support to optimize the care of these patients and to enable them to obtain and survive a liver transplant.[139] Poor nutritional status has been associated with a higher risk of complications and mortality. Moderate to severe malnutrition has been associated with increased requirement for blood products during surgery, more infections post-surgery and longer hospital stays.[3,140]

Adjustments in energy, protein and electrolytes are made based on frequent reassessments of clinical and laboratory data. Requirements for energy are 1.1 to 1.4 X BEE or 25 to 40 kcal/kg, and for protein 1.2 to 1.5 g/kg/d, using estimated dry body weight. The goal for calcium intake is 1200 to 1500 mg along with 400 to 800 IU vitamin D.

Post-Transplant Requirements[3]

Nutritional status during the early postoperative period is affected by graft function, pre-existing malnutrition, the stress response to surgery, the catabolic effects of high-dose steroids, and any postoperative complications such as bleeding, renal failure, sepsis or rejection.

Following transplantation, a liquid-to-solid diet progression is implemented according to patient tolerance. Small, frequent feedings, including high-energy, high-protein supplements, are often necessary until the patient is able to consume adequate nutrients orally. Enteral or parenteral nutrition support may be indicated if oral intake is inadequate. Early postoperative enteral feeding is being used as standard therapy in a growing number of liver transplant centres.

Adjustments in energy, protein and electrolytes are made based on frequent reassessments of clinical and laboratory data. Estimated energy requirements in the immediate post-transplant stage have been reported at 1.2 to 1.75 X BEE or 30 to 45 kcal/kg estimated dry body weight. To account for the increased catabolism of protein after liver transplant, secondary to the catabolic effects of corticosteroids used for immunosuppression and to surgical stress, protein requirements are estimated at 1.2 to 2.0 g/kg.

Patients require intensive, individualized attention to electrolyte and mineral balance immediately post-transplant. Hyperkalemia and hypomagnesemia are common effects of immunosuppressive medications. A potassium-restricted diet and oral supplementation of magnesium are often required. Potassium, phosphorus and magnesium should be monitored closely during diuresis or impaired renal function after transplant. Calcium supplementation (carbonate or citrate) should begin immediately post-transplant, with daily goals of 1500 to 2000 mg/day from food and supplements in combination with 400 to 800 IU/day of vitamin D to curtail bone disease.

Long-Term Management[3]

Nutritional modifications are aimed at prevention of chronic health problems common in transplant patients and frequently associated with immunosuppressive therapy. These include diabetes, hypertension, hyperlipidemia, excessive weight gain and osteopenic bone disease. Diabetes mellitus post-liver transplantation is a common occurrence and is associated with HCV.[141] Energy intake should be adjusted to maintain healthy body weight. Protein needs stabilize as maintenance steroid doses are reached, and are estimated at 0.8 to 1 g/kg. Serum levels of magnesium, phosphorus and potassium should be monitored and the diet adjusted accordingly. Patients with suboptimal calcium intakes require supplementation to ensure an adequate intake of 1000 to 1500 mg/day, with 400 IU/day of vitamin D to prevent steroid-associated bone disease.

Enteral and Parenteral Nutrition

If nutritional intake is inadequate by the oral route and the gastrointestinal tract is functional, the enteral route should be considered. Specific conditions for which it may be indicated include hypermetabolism associated with organ transplantation or HIV/AIDS, nutritional repletion prior to liver transplantation, and organ system failure including hepatic failure. Parenteral nutrition is an option generally reserved for those who have a non-functioning gastrointestinal tract. In severely malnourished patients in whom oral intake has been impaired for many days, feedings should be started slowly to prevent refeeding syndrome.

Enteral Nutrition Support[2,142]

Formulas for cirrhotic patients should be high energy (1.5 kcal/mL) with a lower sodium content (40 mmol/day) for those who have problems with fluid retention.[143] High-energy–density, low-sodium or modular products may be used for patients who need fluid and sodium restriction.[18] Lactulose therapy should be considered, as this may aid in protein tolerance and prevent the need for specialized formulas. The efficacy of some disease-specific formulas is controversial; prudent use of these products is encouraged.[2,5] For those intolerant to standard protein (as evidenced by a decline in mental status), specialized hepatic formulas may be used if the patient fails a trial of standard enteral products. Specialized hepatic formulas (e.g. NutriHep®) are relatively high in osmolarity and high in carbohydrates, which may be poorly tolerated by the hyperglycemic or insulin-resistant patient. Some enteral formulas may not be nutritionally complete; supplementation with vitamins, minerals and trace elements may be needed based on individual requirements. Casein-based formulas may be better tolerated by some. *(Enteral nutrition, see reference 142.)*

Parenteral Nutrition Support[2,144]

Parenteral nutrition involves intravenous nutrition that provides energy and essential nutrients and promotes protein synthesis. For HCV patients who do not tolerate oral or enteral feeding due to intractable vomiting, intestinal obstruction or uncontrolled gastrointestinal bleeding, parenteral nutrition may be indicated. Total parenteral nutrition (TPN) support is more appropriate for patients who require severe fluid restriction. Solutions should be maximally concentrated for those with edema and ascites. Specialized amino acid formulas should be used only if patients are intolerant of standard protein formulas, as evidenced by decline in mental status. BCAA are not necessary for most patients with hepatic dysfunction unless lactulose does not prevent or reduce HE. Electrolyte concentrations, especially sodium and potassium, should be modified as needed. Overfeeding may contribute to TPN-related liver dysfunction. Dextrose provision should not exceed the maximum glucose oxidation rate (3–5 mg/kg/day, or 5–7 g/kg). Excess copper and manganese should be avoided in patients with cholestatic liver disease. *(Parenteral nutrition support, see reference 144.)*

For more information, consult…

- **Practice Essentials** for this chapter (including summary charts of nutrient guidelines)
- **References** for this chapter
- **Resources** for this chapter
- **Appendices D, E**

Chapter 4 – Assessment of Nutritional Status

Health care providers need a core understanding of the principles of nutrition assessment. A thorough nutrition assessment identifies individuals at risk, provides justification for the nutrition care plan, and forms the basis for evaluating the nutrition care plan.[1] The assessment of nutritional status requires information on energy balance, body composition and tissue function.[2–4] At present, there is no consensus on which parameters have the greatest value in assessing nutritional status in chronic liver disease.[2–4]

The patient's nutritional status must be evaluated before intervention is initiated, and should be revisited throughout the care. A complete nutrition care plan addresses the problems identified and outlines plans for monitoring and adjusting interventions. No single component or assessment tool is sensitive and specific enough to be used as the sole indicator of nutritional status. Understanding the multidisciplinary nature of nutrition science and clinical nutrition and having a basic understanding of gastrointestinal tract digestive and absorptive physiology can help sort out the many issues involved.[5]

Factors to Consider in Clinical Nutrition Evaluation

A complete nutrition assessment includes a review of medical history and risk factors, medication profile, nutritional profile (including anthropometrics, body composition, evaluation of dietary intake and comparison with estimated needs), biochemical evaluation, notation of psychosocial and economic conditions, changes in routine, symptoms that interfere with nutritional well-being, and prognosis. In children, additional factors of growth, feeding skills and development of normal motor skills and social patterns should be evaluated.

Assessing nutritional status in patients with advanced liver disease can be difficult because many standard assessment parameters (e.g. body weight, nitrogen balance and serum protein levels) are affected by declining liver function (fluid retention and protein synthesis). The coexisting complications of fluid overload and ascites may mask the severity of malnutrition, particularly in the early stages.

A subjective nutrition assessment tool that includes weight changes, appetite, satiety level, taste changes, diet history and gastrointestinal symptoms is often more useful in this population than standard measures.[3,6–8] Anthropometry, an easily applied technique, can be comparable in accuracy to more sophisticated measuring tools.[9]

Respiratory quotient (R/Q) can be a useful adjunct in the nutrition assessment of patients with hepatic cirrhosis,[10] but requires more expensive indirect calorimetry equipment. A low R/Q indicates reduced glucose and increased lipid oxidation. There is good correlation between R/Q values and serum albumin, creatinine height index and subjective global assessment score. BMI and anthropometric measurements may suggest normal nutrition when, in fact, indirect calorimetry suggests changes consistent with abnormal fuel metabolism and poor nutrition.

As in any population at risk for nutritional status decline, psychosocial and economic issues affect the maintenance of nutritional status and should be included in a thorough evaluation. Additional screening factors such as living environment (e.g. homelessness, home security and access to a stove and refrigerator), income and expenses (including an evaluation of money available for food), and functional status (e.g. ability for self-care and shopping for food and other necessities) can be linked to specific interventions that address problems (e.g. securing housing services, vouchers for food or support services for shopping). Persons at risk for malnutrition based on psychosocial or economic status should be referred to social service professionals for more complete evaluation and intervention. Any major change in health, income or functional status should lead to follow-up nutritional screening.

The following chart provides an outline of factors that are important to consider in a clinical nutrition evaluation of the person infected with HCV. There is a practical focus on clinical and laboratory parameters that can be readily used to evaluate patients in most hospital or clinic settings.

Factors to Consider in Clinical Nutrition Evaluation[1–4,11,12]	
Medical history	Identify risk factors for malnutrition and impact on nutritional status, including polypharmacy, acute and chronic disease events (both related and unrelated to HCV status) and potential medication interactions. ♦ history and current profile of HCV infection ♦ medication or other therapies ♦ substance use ♦ evaluation of gastrointestinal function (e.g. nausea, vomiting, diarrhea, steatorrhea) ♦ comorbidity, including HIV
Dietary history *Sample protocols for dietary assessment methods are available.*[1]	Evaluation of spontaneous nutrient intake allows selection of those at high risk of nutritional deficiencies[2,4] who can then be monitored. Compare actual food and nutrient intake with estimated requirements. Determine appropriateness of types and levels of nutrient supplementation with consideration of medical therapies. ♦ average intake of energy, macronutrients and micronutrients, sodium and fluids ♦ alcohol use ♦ eating pattern (quality and variety); food preferences ♦ changes in appetite, including anorexia; early satiety ♦ changes in taste acuity ♦ dietary restrictions ♦ use of vitamin/mineral supplements ♦ use of complementary or alternative therapies ♦ other factors that may influence the patient's dietary intake (level of physical activity, chewing and swallowing ability, feeding aids or assistance)
Physical examination	Look for clinical signs and symptoms reflecting PEM, nutrient deficiency or toxicity; follow up with appropriate biochemical, anthropometric and dietary data. ♦ These signs and symptoms are not seen until the later stages of impaired nutritional status, and often are not specific to a particular nutrient. ♦ Different clients with the same nutrient deficiency may present with different signs and symptoms.
Anthropometry and body composition *BMI, see Chapter 2 and BMI chart in Resources for Chapter 4*	Used to estimate nutritional status and evaluate changes in response to treatment.[1,2–4,11,13–16] **Body Weight**[1,2,11,13,15,17] Usual body weight (UBW) and weight change can be indicators of nutritional risk, particularly if weight change occurs rapidly or unintentionally, as it reflects changes in body protein, water, minerals and fat.[1] % UBW = current body weight / UBW X 100 % weight change = (UBW – current weight) / UBW X 100 (a change ≥10% is often interpreted as high risk) Body Mass Index (BMI) ♦ BMI is widely accepted as a simple and fairly accurate way to assess body weight in relation to height for most people between 20 and 65 years of age. ♦ BMI evaluates weight independent of height, and may be correlated with mortality and other health-related factors. It is not useful for assessing the weight of very muscular people, athletes, and pregnant or nursing mothers. ♦ It is not a measure of body fat percentage, and varies with body composition in relation to gender, age and ethnicity. ♦ To evaluate body fat percentage, BMI should be accompanied by skinfold thickness, waist circumference or waist-to-hip ratio. When to question validity of body weight: ♦ In liver failure: due to fluid shifts that occur owing to edema, ascites and diuretic therapy (fat tissue would be overestimated). ♦ In malnutrition: a shift of fluid from the intravascular to the extravascular space, with concurrent decrease in lean body mass (loss of lean body mass may occur with no change in body weight). Using body weight to estimate energy and protein needs: ♦ When significant ascites and edema—base on adjusted body weight, usually a reference desirable weight or an estimate of dry weight.[6] ♦ When obese—use adjusted ideal weight: (actual – ideal weight) X 0.25 + ideal weight

Factors to Consider in Clinical Nutrition Evaluation[1–4,11,12]	
Anthropometry and body composition *(cont'd)*	Creatinine height index (CHI) is affected by several factors: ♦ Hepatocyte damage can decrease the formation of creatinine and alter measures of CHI. ♦ PEM and aging can decrease body cell mass and result in a decrease in CHI. **Somatic Protein Compartment**[1,2,11,14–16] **Body circumferences and areas** Used to estimate skeletal muscle mass (somatic protein stores) and body fat stores. Often used as quick screening tools to identify those at risk for undernutrition or overnutrition, and can be helpful in situations where height and weight cannot be measured. Inappropriate if ascites is present. ♦ **Waist circumference** correlates with visceral fat stores. Values >102 cm in men and >88 cm in women may indicate increased risk for cardiovascular disease (CVD) and type 2 diabetes. ♦ **Waist-to-hip ratio** estimates the distribution of subcutaneous and intra-abdominal adipose and muscle tissue. Ratios of >1.0 in men and >0.8 in women may indicate increased risk for CVD and type 2 diabetes. **Anthropometric measures** (including mid-upper-arm circumference, mid-arm muscle circumference, and skinfold thickness) can be used for patients with liver failure.[18] ♦ Serial measurements should be used to assess changes over time rather than comparing with standard measures. ♦ Measurements at the arm are less affected by fluid shifts and can be useful to estimate fat and muscle reserves.[18]
Biochemical data (laboratory values)	May be altered by nutrients, medications or illnesses, and can be used to detect subclinical nutritional deficiencies. Identify alterations from expected values and evaluate for potential causes and consequences (interpret laboratory values with consideration of medication and medical profile of infection or concomitant disease). **Visceral protein status** Visceral proteins reflect serum proteins, erythrocytes, granulocytes, lymphocytes and solid tissue organs.[1] They provide a measure of hepatic transport proteins, and correlate more closely with the degree of liver damage than with the degree of PEM. ♦ *Serum albumin* will remain normal until <25% of hepatocytes are functioning. It maintains colloid oncotic pressure within the body; in liver disease, serum albumin levels may be used as markers of liver function as well as nutritional status. ♦ *Serum transferrin* is generally thought to be a more accurate measure of nutritional status due to its shorter half-life. However, serum concentrations are affected by many of the same factors as albumin. It is generally decreased in PEM and certain disease states, including liver disease. ♦ *Thyroxine-binding prealbumin* levels generally decrease with liver disease and malnutrition. They can be decreased acutely by non-nutritional factors, such as bleeding and infection that cause an immediate need for protein synthesis; thyroid function will also affect levels. ♦ *Retinol binding protein* levels generally decrease with liver disease. They are sensitive to protein and energy changes, and can be affected by non-nutritional factors. **Micronutrient measurements** Assessment of micronutrient status through serum measures generally has poor sensitivity and specificity due to the homeostatic nature of most micronutrients and their small serum pool. These should be evaluated concurrently with other assessment methods. ♦ Serum sodium – in ascites ♦ Serum magnesium – in cirrhosis, particularly if malabsorption or hepatic bone disease ♦ Serum zinc – not very reliable ♦ Serum vitamin D – in cirrhosis ♦ Serum calcium – in cirrhosis

Factors to Consider in Clinical Nutrition Evaluation[1–4,11,12]	
Estimation of energy, protein and fluid requirements	**Energy needs** Indirect calorimetry is the gold standard for energy expenditure estimation as it is more accurate than using predictive equations, particularly in critical care settings where overfeeding may become an issue. It may also be more cost beneficial.[1] If indirect calorimetry is not available, the following provides two reasonable estimates of energy needs for patients undergoing physiological stress, such as those with infection: ♦ 25 to 40 kcal/kg, based on dry weight or an adjusted ideal weight[2,3,19,20] or ♦ add 20% to 40% to basal energy expenditure (BEE) using the Harris–Benedict equation.[21–25] In malnourished patients, energy needs are 1.5 to 1.75 X BEE or 35 to 40 kcal/kg.[25] Energy estimation in obesity ♦ The use of predictive equations in obesity to estimate energy expenditure has been a highly debated topic with little research to support actual practice. For the Harris–Benedict equation, guidelines include using actual weight; using actual weight for BMI>40 and ideal weight for BMI>40; and using the average of actual and ideal weights. **Protein needs** — An intake of 1 to 1.5 g/kg is recommended, depending on the patient's situation. *See Chapter 3*. **Fluid needs** — *See Chapter 3*.
Psychosocial and economic factors	Determine adequate availability of resources to support nutrition and any considerations required for interventions. ♦ socio-economic status ♦ cultural or religious background ♦ language and literacy level ♦ living arrangements; caregiver support ♦ family/friend dynamics that support or interfere with nutritional status maintenance ♦ access to medical services and products, food and other resources ♦ food beliefs ♦ food resources – food security, cooking ability, shopping arrangements ♦ use of CAM therapies
Subjective Global Assessment (SGA)	Developed as an alternative means of assessing nutritional status without using objective measures.[1,12] ♦ Based on client's medical history and physical examination, and has been validated against objective measures. Final SGA ratings have high levels of interobserver reproducibility. ♦ Should not be relied upon as the sole nutritional assessment tool, due to limitations found with all nutrition assessment tools. ♦ A sample SGA measurement protocol is available.[1,12]

Counselling Guidelines and Recommendations

Strategies for nutrition care should specifically address risk factors or other problems (e.g. inadequate food access, decreased nutrient intake and body composition changes).[26] Desired nutrition-related outcomes may include the preservation of lean body tissues, normalization of laboratory values, improvement in quality of life, and support for efficacy and tolerance to medications and other treatments. (*Coping with discomforts and treatment side effects, see Chapter 5.*)

The health care provider should assist the patient and others supporting patient care to establish realistic and individualized goals to meet the nutrition needs identified. The nutrition goals should align with the goals of the overall health care plan and consider:

- feasibility of nutritional repletion
- patient prognosis and desire for well-being
- the medical treatment plan
- the health care setting in which the nutrition care will be provided (e.g. outpatient clinic, long-term care or residence, home care or acute care)
- circumstances in the home that may have an impact on implementation of recommendations

The nutrition care plan requires monitoring and may need ongoing adjustment. Nutrition-related outcomes evaluation should be included with the quality assurance measures to assess other health interventions.

Specific counselling recommendations should address the following areas as appropriate for the individual client:

- healthy eating principles to ensure adequate nutrient intake *(See Chapters 2 and 3.)*
- a healthy eating plan, including examples of recommended foods and amounts *(See Resources for Chapters 2 and 3; Appendices A and B.)*
- food skills, including food shopping, storage, safety, preparation and dining away from home *(See Chapter 8.)*
- perinatal nutrition and breastfeeding issues for HCV-infected mothers of newborn children
- nutrition strategies for management of disease symptoms or treatment side effects (e.g. fatigue, anorexia, early satiety, nausea and vomiting, diarrhea, food intolerances, and other barriers to food intake) *(See Chapter 5.)*
- psychosocial and economic issues that may prevent appropriate nutrient intake, including referral and access to community resources that help to support nutrition and health *(See Chapter 7.)*
- alternative feeding methods (supplementation, enteral, parenteral) *(See Chapter 3.)*
- additional therapies that support nutrition, including physical activity and exercise, and medications for symptom management and disease management *(See Chapter 2.)*
- guidelines for the evaluation of nutrition information and claims for special diets, individual vitamin and mineral supplementation, and other complementary and alternative medical/nutrition practices *(See Chapter 6.)*

For more information, consult…

- **Practice Essentials** for this chapter
- **References** for this chapter
- **Resources** for this chapter

Chapter 5 – Dealing with Symptoms and Treatment Side Effects

Many persons infected with HCV experience discomforts, due either to symptoms of the disease or to side effects of treatment. Studies suggest that patients with chronic hepatitis C, even without major disease-related complications, perceive themselves to be unwell and have significant changes in their physical and mental well-being.[1] Most people who undergo treatment for hepatitis C experience side effects; however, not everyone experiences the same side effects from the same treatment, nor can the severity be predicted. There are ways to help patients feel more comfortable and maintain their nutritional status.

Common Symptoms and Treatment Side Effects Associated with Hepatitis C[2–8]

Potential Symptoms of HCV Infection	Potential Side Effects of Treatment	
	Nutritional	**Other**
♦ fatigue ♦ anorexia ♦ early satiety ♦ nausea or vomiting ♦ indigestion ♦ diarrhea ♦ changes in taste ♦ swelling ♦ pain ♦ sleep disturbance ♦ depression ♦ cramps	♦ nausea, vomiting ♦ diarrhea ♦ anorexia ♦ changes in taste ♦ oral sores ♦ weight loss ♦ high blood sugar levels in people with diabetes ♦ high serum triglycerides ♦ hemolytic anemia	♦ fatigue ♦ fever and chills ♦ feeling anxious, irritable or depressed ♦ headaches and muscle aches ♦ joint pain ♦ hair loss ♦ insomnia ♦ dry, itchy/irritated skin, or rash ♦ shortness of breath ♦ chest pain

Strategies for Coping with Symptoms and Treatment Side Effects

Health care providers should encourage patients to report any discomforts so they can receive assistance in managing them. (*See Appendix F.*) Those with severe nausea and vomiting are at risk of dehydration, electrolyte imbalances, abnormal metabolism and weight loss. The severity of the condition will dictate the course of action. Emphasize eating foods that are well tolerated. People on antiviral treatment should be encouraged to eat a well-balanced diet, drink plenty of water and be physically active.

Medications are sometimes used to help manage side effects of treatment. Other side effects might go away by themselves, or become less unpleasant with time. For example, flu-like symptoms often diminish with continued treatment.[4]

Diet for High Triglycerides

The following tips may help those experiencing high blood levels of triglycerides:

- Achieve or maintain a healthy body weight through appropriate food selection and physical activity.
- Avoid alcohol.
- Reduce general intake of sweets or other refined carbohydrates. Limit intake of fruit juices and sugar-sweetened beverages.
- Consume a balanced diet low in saturated fats and high in fibre.
- Eat frequent, small meals rather than one or two larger meals.
- If serum triglycerides are >1000 mg/dL (11.3 mmol/L), a low fat diet is indicated.[9]

For more information, consult…

- **Practice Essentials** for this chapter
- **References** for this chapter
- **Resources** for this chapter
- **Appendices C, F**

Chapter 6 – Complementary and Alternative Therapies

Complementary or alternative medicine (CAM) therapies are "medical and health care practices that are not an integral part of conventional (Western) medicine."[1] They can be classified into five categories: biologically based therapies, mind–body medicine, alternative medical systems, manipulative and body-based systems, and energy-based systems. The category of biologically based systems includes vitamin/mineral supplement therapy and herbal remedies, the main focus of this chapter. More comprehensive reviews of CAM in chronic liver disease[1] and hepatitis C[2] are available.

Many people with chronic liver disease, particularly hepatitis C, are interested in CAM remedies,[1,3] especially when the virus has failed to respond to antiviral treatment. However, the expanded use of CAM by patients often occurs without the advice or knowledge of their health care provider.[1,4]

No herbal, diet supplement or alternative medicines have been proven to cure or even relieve symptoms of hepatitis C. At this point, all such treatments should be considered experimental. Safety is the first concern. However, many people see these products as safe because they are "natural". As part of the nutrition assessment, it is important to determine the type of herbal preparations and supplements used, the extent to which these replace nutrition intake, the risk of interactions or potential toxicities with conventional antiviral treatment, and the risk of damage to the compromised liver. As well, potential harmful effects of herbal preparations and mega-doses of vitamins/minerals must be discussed with the patient. CAM therapies that are safe should be taken only under the guidance of a health care provider.

Some Questions to Consider When Evaluating a Therapy[5]

- Has the therapy been proven to be more effective than providing no intervention?
- Is the therapy as safe as doing nothing?
- Does the potential for benefit exceed the potential for harm to the patient and family?
- Have proponents of the therapy demonstrated its efficacy and safety?
- What is the cost of the therapy and financial implications for the patient?

The Naturopathic Approach

The naturopathic approach to managing hepatitis C is to strengthen the key lines of defence in dealing with antigenic substances believed capable of crossing the intestinal barrier.[1] Thus, a therapeutic trial in naturopathic medicine would include efforts to:

- "enhance the terrain", using agents to improve gastrointestinal, liver and immune functions
- remove obstacles to cure by increasing excretion or chelation of pro-oxidant compounds (e.g. iron) and lowering the toxic burden (by eliminating alcohol, smoking and drugs)
- improve healing of the liver

In addition, therapy is individualized according to host characteristics, such as the degree of oxidative stress or imbalance. The holistic approach is maintained by guided imagery or support group therapy focusing on quality of life.[1]

A review of CAM treatments for hepatitis C describes various botanicals and plant extracts with potential immunomodulatory and antiviral effects, as well as antioxidants.[6] A review of natural products, herbal and nutritional supplements for patients with HCV has been published.[7] While recognizing the need for controlled trials, the authors advocate a conservative approach using diet and lifestyle modification, along with interventions whose intensity is tailored to the clinical severity of the disease and the response of the patient. They outline a suggested diagnostic and case management protocol, and provide a list of potential naturopathic treatment interventions organized by the level of research support.[7]

Vitamin/Mineral Supplements

Oxidative stress appears to play a role in the pathogenesis of hepatic injury. Nutritional antioxidants are attractive potential therapeutic and chemopreventive agents because they are inexpensive and have a relatively low toxicity profile. Specific vitamins and minerals, such as vitamin E and selenium, have shown early promise of beneficial effects for persons infected with HCV.

It has been recommended that at this time antioxidant therapy be restricted to randomized, controlled clinical trials in which treatment effects can be closely monitored and therapeutic efficacy can be determined with scientific accuracy.[8] *(Evidence and appropriate use of vitamin and mineral supplements, and obtaining antioxidants from food, see Chapter 3.)*

Herbal Products

It is estimated that herbal preparations are used by 20% of liver disease patients.[1] Some persons infected with HCV turn to herbs to deal with either the hepatitis itself or the side effects of treatment. A small number of scientific studies on the effects of herbal remedies on hepatitis C have been conducted, but few have been published in peer-reviewed journals. The National Center for Complementary and Alternative Medicine has published a review of treatment alternatives for hepatitis C. Its position at this point is that all such treatments should be considered experimental.[2]

- Some herbal treatments have been shown to be hepatotoxic, and some enhance or reduce potency of prescribed medications.
- A few herbal treatments have been shown to be of potential benefit to persons with hepatitis C, though none has been shown capable of clearing the virus.
- Much additional research is needed before any such products could be considered a standard treatment option.
- Further controlled trials are needed to clarify the therapeutic effects of herbal treatments and establish safe and effective usage levels.
- Botanicals are often crude mixtures containing many chemical compounds. The chemical constituents may not be well characterized, the active ingredient may be unknown, or there may be multiple active ingredients.

The most commonly used herbal treatment for hepatitis C is milk thistle (silymarin).[1] Other popular ones are glycyrrhizin, HM861, TJ-9, ginseng, ginger root and St. John's wort. Many of these have been shown to protect against experimental liver injury in vivo, and most possess one or a combination of antioxidant, antifibrogenic, immune modulatory or antiviral activities. However, none has been shown to be effective in ameliorating the course of chronic liver disease in well-conducted random controlled trials. Development of reliable information on the safety and efficacy of botanicals is impeded by incomplete understanding of their modes of action, lack of standardization in their manufacture, and complexity of the chemical ingredients in the average herbal extract.

Herbs Known to Be Toxic

A key concern is that some plant substances are hepatotoxic. Some herbs may be an added stress to an already compromised liver, thereby increasing liver damage. Because the evidence is so limited, the only way to reduce the risk of liver damage is to limit the use of herbal products, and to avoid the herbs that are known to be hepatotoxic.

Herbs That Are Hepatotoxic[1,2,9–12]	
Artemesia	Kombucha mushroom (tea)
Atractylis gummifera	Ma-Huang (*Ephedra sinica*)
Bush tea	Margosa oil
Callilepsis laureola	Mate (Paraquay) tea
Chapparal leaf (creosote bush, greasewood)	Mistletoe
Comfrey (*Symphytum officinale*)	Pennyroyal (squawmint oil)
Crotalaria	Sassafras
Germander	*Senecio aureus*
Gordolobo herbal tea	Senna
Heliotropium	Skullcap
Jin-Bu-Huang	Symphytum
Kava (*Piper methysticum*)	Valerian root

Health Canada has ordered that the sale of all products containing the herb kava be halted because its use has been associated with serious liver dysfunction.[13] It considers products containing kava to be drugs and has determined there are no acceptable food uses.[δ]

[δ] For the Health Canada Advisory on kava, as well as information on reporting suspected adverse effects, including liver toxicity, see <www.hc-sc.gc.ca/english/protection/warnings/2002/2002_56e.htm>.

Herbs That May Help Liver Function

The modes of action of the herbal remedies that have undergone trials have not been precisely identified; generally, they seem to enhance the resistance of hepatic cells to damage by viruses and/or other agents. Two reports[1,2] outline treatment alternatives for hepatitis C.

Some Compounds with Possible Efficacy in Liver Diseases[1,2,12]

Compound	Putative Biological Mechanism*	Targeted Liver Disease
Silymarin (Milk Thistle)	-biologically active compound is silibinin -antioxidant and free-radical scavenger -in animals, prevents glutathione depletion and free-radical formation in liver -may also be antifibrotic through indeterminate mechanisms	-cirrhosis -government-sanctioned use in Europe: chronic liver disease, digestive disorders, gallbladder disease
Glycyrrhizin (Licorice root)	-multiple constituents of licorice root appear to inhibit 11-beta-hydroxysteroid dehydrogenase, thus anti-inflammatory in inhibiting prostaglandin production and modifies arachidonic acid metabolism -antioxidant properties – induces glutathione-S-transferase and catalase -may have antiviral properties	-used traditionally for cough, bronchitis, gastritis, chronic hepatitis, liver inflammation -fibrosis -because of mineralocorticoid activity, avoid in persons with cirrhosis
Herbal Medicine 861 (combination of 10 herbs)	-herbal mixture that often includes glycyrrhizin -blocks stellate cell activation through inhibiting cell cycle progression	-fibrotic liver disease
TJ-9 (Sho-saiko-to)	-herbal mixture that often includes glycyrrhizin -blocks stellate cell activation -inhibits lipid peroxidation in hepatocytes and stellate cells	-fibrotic liver disease
TJ-41	-herbal mixture; induces cellular apoptosis via P53	-hepatocellular carcinoma
TJ-108	-herbal mixture with active compound Gomisin A which has antiviral properties	-hepatitis C virus (reduction of HCV-RNA levels)
Liv-52	-herbal mixture; hepatoprotective	-government-sanctioned use in India: alcohol-induced liver disease

*determined in animal models or by in vitro assays; mechanisms in humans not identified

Milk Thistle – Among potential herbal therapies for hepatitis C, the most promising is the herb commonly called milk thistle (*Silybum marianum*). Silymarin is the ingredient experts believe is responsible for its potential medicinal qualities. Preliminary studies in animals show that milk thistle may help protect the liver from injury by a variety of toxins (drugs, viruses, alcohol, radiation and poisonous mushrooms) and limit their damaging effects.[14,15] Experimental data indicate that silymarin acts as an antioxidant and free-radical scavenger and prevents glutathionine depletion and free-radical formation. It is difficult to derive conclusions as most studies on milk thistle include small sample sizes with different types and severities of liver disease.[16]

No randomized controlled studies of silymarin therapy for chronic hepatitis C or other specific forms of chronic liver disease have been conducted. Pilot studies suggest that it does not cure liver disease, but that it may improve liver function in patients with cirrhosis.[14] It does not lower HCV-RNA levels, but may decrease ALT levels. One small, randomized controlled trial suggests that silybin, a component in silymarin, may be beneficial in managing chronic hepatitis;[17] however, it may interfere with treatment.

In Germany, where many herbs are regulated and prescribed like drugs, health authorities have approved milk thistle as a complementary treatment for cirrhosis, hepatitis and similar liver conditions.[15] Because milk thistle does not dissolve well in water, it is not effective in the form of a tea. In the US, it currently is marketed as a dietary supplement in the form of capsules containing 200 mg of a concentrated extract with 140 mg of silymarin.[2]

Licorice Root – Herbalists use tea made with licorice root (*Glycyrrhiza glabra*) to manage some of the effects of hepatitis on the liver. The active component is glycyrrhizin. Studies suggest that licorice root displays antiviral and anti-inflammatory properties.[18] In Japan, glycyrrhizin has been used for more than 20 years as a treatment for chronic hepatitis; a product called Stronger Neominophagen C

(SNMC), containing glycyrrhizin, cysteine and glycine, is used to treat acute and chronic hepatitis. Glycyrrhizin is a common component of many herbal medications, including TJ-9 and Herbal Medicine 861 (HM861). In the US, it is available over the counter in liquid, powder and pill forms, with daily doses of 5 g to 15 g of the root, equivalent to 200 mg to 600 mg glycyrrhizin.

A 1998 review[19] of several randomized controlled trials reported that treatment with glycyrrhizin is effective in easing liver disease in some people. Several of the trials reviewed indicated improvements in liver tissue that had been damaged by hepatitis. Some also showed improvements in liver function. A 1997 study suggested that glycyrrhizin may also help prevent the development of liver cancer in patients with chronic hepatitis C;[20] however, this trial was not prospective or randomized, varying doses were used and some patients received other unknown herbal therapies. The use of glycyrrhizin as a complementary therapy in addition to conventional use of interferon drugs has been studied, but no significant benefit has yet been found.[21,22]

This agent should be avoided in persons with cirrhosis. Because of its mineralocorticoid activity, treatment with glycyrrhizin can cause side effects that include worsening of symptoms of cirrhosis, including fluid retention and hypokalemia. If taken regularly (more than 3 g/day licorice root for more than 6 weeks, or >100 mg/day glycyrrhizin), this herb can cause the following conditions in some people: high blood pressure, sodium and water retention, low serum potassium levels, and disturbance of electrolyte balance. Signs and symptoms of excessive licorice root consumption may include headache, sluggishness, peripheral edema, and even heart failure or cardiac arrest.[23]

Ginseng – Tests on animals and on human tissues suggest that ginseng may help the body's disease-fighting and glandular systems. Tests in small animals also suggest that ginseng may help improve liver function and reduce damage to liver tissue caused by hepatitis and similar conditions.[24–26] However, no studies have been found in people that test ginseng's effect on hepatitis. Only one study shows that ginseng may be beneficial for elderly people with liver conditions similar to hepatitis.[27]

There are two true ginsengs—American ginseng (*Panax quinquefolius*) and Asian ginseng (*Panax ginseng*), which includes Chinese, Japanese and Korean ginseng. Siberian ginseng (*Eleutherococcus senticosus*) is not a true ginseng.[14,28] It is difficult to obtain authentic ginseng products, and the quality of the different brands varies widely. A 1990 analysis of 54 available ginseng products revealed that 85% contained little or no ginseng.[28] Ginseng is most often taken as a tea.

Herbs That May Ease Interferon's Effects

Ginger Root – For 2500 years, the Chinese have used ginger root (*Zingiber officinale*) to treat nausea; some, but not all, research studies confirm that ginger may be effective for this purpose.[14] This herb may relieve nausea and vomiting caused by interferon treatment in some patients with hepatitis C; however, safety and efficacy over the long term have not been proven. It is relatively inexpensive and readily available, most commonly taken in the form of capsules or a tea.

St. John's Wort – Some patients with hepatitis C take the herb St. John's wort (*Hypericum perforatum*) to treat depression caused by interferon treatment. Although not a proven treatment for depression, studies have shown that St. John's wort does have antidepressive effects over the short term. There is no proof yet that St. John's wort is effective and safe over the long term. Research has largely been done using capsules of this herb, but St. John's wort is also taken as a tea. The herb is less expensive and may have fewer side effects than prescription antidepressant drugs.[29] Tests in humans reveal it may cause side effects such as fatigue, dry mouth, dizziness, digestive tract symptoms and increased sensitivity to sunlight. It has not been shown to have detectable anti-viral activity in patients with chronic HCV infection. It is contraindicated for liver transplant patients because it interacts with immunosuppression drugs.

A Cochrane Review

A Cochrane review[30] describes 10 randomized trials, including 517 patients with mainly chronic hepatitis C, which evaluated 10 different medicinal herbs versus various control interventions (four placebo, four interferon, two other herbs). The methodological quality was considered adequate in four trials and inadequate in six trials.

- Compared with placebo in four trials, none of the medicinal herbs showed positive effects on clearance of serum HCV-RNA or antibodies, or on serum liver enzymes, except one short-term trial in which a silybin preparation showed a significant effect on reducing serum AST and gamma-glutamyltranspeptidase activities.

- The herbal compound Bing Gan Tang combined with interferon-alpha showed significantly better effects on clearance of serum HCV-RNA and on normalization of serum ALT activity than interferon-alpha monotherapy.
- The herbal compound Yi Zhu (decoction) showed a significant effect on clearance of serum HCV-RNA and normalization of ALT levels compared to glycyrrhizin plus ribavirin.
- Yi Er Gan Tang showed a significant effect on normalizing serum ALT compared to silymarin plus glucurolactone.

Blended Herbal Formulations

Chinese Traditional Medicine has been practised for some 2000 years. Chinese herbal therapy comprises more than 100,000 recorded treatments, with about 80% being combination or herbal mixtures—multi-ingredient prescriptions with proportions of herbs individualized to each client by the prescriber. In the absence of standardized clinical trial data, it is impossible to assess the efficacy. Case reports do not constitute strong enough evidence of therapeutic effect, particularly in view of the variability of the natural history of HCV infection, with some patients able to clear the virus without treatment and others remaining well while still carrying the virus. The placebo effect accounts for a significant proportion of patients (about a third) reporting feeling better when on any therapy.

Case studies relating to the use of herbal products by patients with hepatitis C suggest that an improvement in fatigue and liver enzyme levels may occur with the use of certain Chinese herbs.[31] A standardized Chinese herbal preparation known as CH100 has been shown to improve liver function tests in some people with hepatitis C, but does not clear the virus.[32] A review has been published that focuses on traditional Chinese herbal medicine in hepatitis C.[33]

For more information, consult…
- **Practice Essentials** for this chapter
- **References** for this chapter
- **Resources** for this chapter

Chapter 7 – Nutritionally At-Risk Groups

According to the population health model, broad determinants of health can influence nutritional health.[1] It is important to assess the medical, social and food security profile of the patient with hepatitis C and modify nutrition advice to support the individual's needs. This chapter describes two categories of patients with hepatitis C that would be considered nutritionally at risk, either due to concomitant medical conditions or as a member of an at-risk population or lifestyle group.

Concomitant Medical Conditions

Human Immunodeficiency Virus (HIV)

Coinfection with HIV results in increased morbidity and mortality in the HCV population.[2] Because of the similar transmission routes, coinfection with HCV and HIV is common,[3,4] with a prevalence of between 50% and 90%.[3,5] As of December 1999, an estimated 11,194 persons in Canada were co-infected with HCV and HIV.[3] Of these, the vast majority (85%) represented injection drug users, including those with and without same sex exposure.[3] Guidelines for nutrition care of persons with HIV infection are available.[6,7]

The immunodeficiency associated with HIV infection appears to accelerate the course of HCV,[4,8,9] with a more rapid progression from active hepatitis to cirrhosis, to ESLD.[4,5,10] Coinfection is associated with higher hepatitis C viral loads,[5,10,11] and HCV infection mimics opportunistic diseases.[12]

In turn, chronic HCV infection may accelerate the clinical and immunological progression of HIV disease;[12] however, reports are conflicting. A recent prospective cohort study did not detect evidence that HCV infection substantially alters the risk of dying, developing AIDS, or responding immunologically to highly activated antiretroviral therapy (HAART), especially after accounting for differences in its administration and effectiveness.[13,14]

Impact on Treatment

As new antiviral treatments for HIV are allowing patients to live decades longer, many more will have to face hepatitis C treatment decisions. HIV/AIDS therapies affect the liver, and hepatitis C therapies affect the immune system. The impact of treatment of either virus on the natural history of the co-infected patient remains speculative.[4] The potential hepatotoxic effects of antiretroviral therapy may be enhanced in the co-infected patient, particularly if cirrhosis is present, and could have a negative impact on the liver disease due to HCV.[4] As the pathogenesis of hepatitis C depends on the host immune response, improvements in immunity following the introduction of HAART could cause a flare-up in hepatitis C–related liver disease.[4]

Diabetes

Diabetes mellitus is a metabolic disease characterized by hyperglycemia and associated with short- and long-term complications.[15] A higher prevalence of diabetes is seen among persons infected with HCV,[16–18] and chronic hepatitis C may contribute to the development of diabetes. Diabetes mellitus has been reported to be more prevalent in patients with HCV compared to those with hepatitis B[19] and those with other types of liver diseases, usually in the absence of predisposing factors.[18]

A cross-sectional national survey in the US found that HCV-infected persons were at least three times more likely to have type 2 diabetes than those without HCV infection, after adjustment for confounding variables including age, BMI, poverty level and history of drug and alcohol use.[17] Others have confirmed that among HCV-infected patients with cirrhosis, the increased risk of diabetes is not explained by cofactors (age, sex, BMI, hepatitis G virus coinfection, hepatitis C virus genotype).[20] This increased risk exists even in HCV-infected persons without liver cirrhosis and may be related to fat and iron depositions in the liver, which are common features among patients with HCV infection.[20] (*See hemochromatosis section below.)*

Impaired glucose tolerance with accompanying insulin resistance and hyperinsulinemia occurs commonly in cirrhotic patients.[21–24] It usually precedes the development of diabetes mellitus in 10% to 20% of these patients.[16,20,25,26] *(Alterations in carbohydrate metabolism in HCV, see Chapter 3.)*

Appropriate food choices consistent with CFGHE, along with slow, steady weight loss where necessary, can aid in achieving and maintaining optimal blood glucose control. Medical nutrition therapy, blood glucose monitoring, medication and physical activity are integral components of diabetes care and

management. Blood glucose and insulin response are influenced by both the source and the amount of carbohydrate consumed, with priority given to the total amount of carbohydrate consumed at each meal or snack. Including more foods and food combinations that include cereal fibre with low glycemic index may be helpful in optimizing health outcomes for persons with diabetes or at risk for diabetes.[27] Guidelines for nutrition care of persons with diabetes are available.[15,27]

Hemochromatosis

Hemochromatosis is a disease in which there is an inappropriate absorption of iron from the intestine. The excessive iron then accumulates in the liver, pancreas and other organs in the body, causing damage. Patients with this disease should not be given iron supplements. Manifestations can include diabetes mellitus, hepatic dysfunction, arthritis, skin pigmentation changes and congestive heart failure; if damage appears in other organs, further dietary recommendations may be indicated. Aside from these precautions, those with hemochromatosis may follow a normal diet. Treatment is achieved by frequent removal of blood from a large vein. Iron deposits in the liver are common among patients with HCV infection, suggesting that those who also have hemochromatosis would be at additional risk for liver damage due to excess iron.

Hepatitis B

The prevalence of the combination of both hepatitis B and hepatitis C infections in Canada is unknown.[5] Published reports indicate that the worldwide prevalence ranges between 3.4% and 18.3% in various series of patients with hepatitis C.[5,28] Coinfection appears to result in more severe disease.[5,29–32] The risk of HCC is increased compared to the risk with hepatitis B or hepatitis C alone.[5]

Renal Disease

The person with renal disease is already at higher nutritional risk. Hepatitis C is particularly difficult to treat in patients with co-existing renal insufficiency because the therapy may exacerbate renal disease or complicate management of dialysis or kidney transplantation. Chronic renal failure results in increased morbidity and mortality in the HCV population.[33] Guidelines for nutrition care of persons with renal disease are available.[34]

At-Risk Population or Lifestyle Groups

Children and Adolescents

Compared to adults, knowledge of HCV infection in children is limited because there are many fewer children infected with HCV,[35] and they are less likely to have symptoms from their HCV infection. In general, childhood liver disorders have modes of presentation distinct from those in adults.[36]

Children with chronic liver disease should undergo periodic nutritional assessment.[37] Because of the increased risk for growth failure and developmental delay, children should be referred for full nutrition evaluation as soon as possible after diagnosis. A combination of anthropometric, dietary intake and medical data can be an indicator of nutritional risk in the HCV-infected child and may be useful for measuring more subtle changes in nutrition status. Psychosocial and economic issues may become barriers to appropriate food intake and should also be considered.

Aboriginal Peoples

The rate of HCV infection among Canada's Aboriginal peoples may be seven times higher than for non-Aboriginal Canadian-born people.[38]

Cross-cutting issues Aboriginal people may be facing include poverty, food insecurity, violence and difficult living conditions. Many of the communities are remote and have limited access to local health services and qualified health professionals.[39] They also face higher rates of other diseases. Among First Nations people, the prevalence of diabetes is at least three times the national average.[39] Unlike the overall AIDS epidemic where the annual number of new cases has levelled off, the number of AIDS cases among Aboriginal people has increased steadily over the last decade.[40] The increase can be attributed in part to the fact that Aboriginal people are over represented in high-risk groups such as injection drug users and prison inmates. Because of the high mobility of many Aboriginal people, the HIV risk found in the inner city can be transferred to even remote Aboriginal communities. Injection drug use has not traditionally been a topic of discussion in most Aboriginal communities.

Alcohol and Substance Use

For a person with hepatitis C, substance use may have an important negative impact on disease outcome.[31,32,41] Substances used may include alcohol, illicit drugs, inhalants, and prescription and over-the-counter medications. The prudent choice for persons infected with HCV is to abstain from drinking alcohol or taking illicit drugs. Avoidance at diagnosis is best, but decreasing or stopping at any time should also be encouraged. Only medication prescribed by or on the advice of a physician should be used.

Health care providers should detect the use of harmful substances through screening and assessment procedures and refer to appropriate services and programs. Information is available on nutrition care for individuals undergoing treatment for chemical dependency, including dietary suggestions that have proven useful for treating the symptoms associated with withdrawal.[42]

Sustained substance use is common among certain subgroups of the population. Anyone who is addicted to alcohol or other substances may be living a chaotic lifestyle compounded by many stress factors, and place healthy eating low on their list of daily priorities. A comprehensive prevention and harm reduction approach would address the psychosocial factors associated with injection drug use, the environment in which unsafe behaviour occurs, and the provision of basic life necessities.

Poverty and the Link with Nutrition

Poverty is related to nutritional vulnerability. The number of people using food banks in Canada has almost doubled since 1989,[43] and 20% of those with incomes below $25,000 say they cannot afford a healthy diet.[44] Poverty is frequently interrelated with other factors.[45] Those with lower household income levels tend to rate their knowledge of nutrition lower than those with higher income levels, and perceived knowledge of nutrition correlates with the overall importance attributed to nutrition.[46] Attitudes and knowledge toward nutrition are important underpinnings to action.

Violence and the Link with Nutrition

Scientific research is limited that directly links the negative effects of family violence to the outcome of persons infected with HCV. However, people who live in constant fear of physical, psychological, verbal, sexual or financial abuse may consider planning meals, shopping and cooking low priorities. They may eat irregularly or erratically and have difficulty eating at all. For some abused persons, alcohol, drugs and medication may replace healthy eating. In a national survey, one quarter of the women who reported that they had lived with violence said they had turned to these substances to help them cope with their situation.[47] Taking drugs or medications to help themselves sleep, calm down and/or get out of depression was also commonly reported in another national survey, with women twice as likely as men to report doing so.[48]

For more information, consult…

- **Practice Essentials** for this chapter
- **References** for this chapter
- **Resources** for this chapter
- **Appendix A**

Chapter 8 – Skills for Healthy Eating

Persons infected with HCV may face challenges around healthy eating that relate to planning, grocery shopping and preparing healthy meals. This chapter provides some guidance to health care providers on coping with those challenges.

Ability to Plan, Shop and Cook

Healthy eating requires the knowledge and ability to plan (which includes budgeting and meal planning), grocery shop and prepare healthy meals. Many persons infected with HCV face additional challenges due to a limited budget, limited energy, nausea and food aversions.

- Learning about and practising food selection and meal planning skills will facilitate long-term compliance to healthy eating.
- People are more likely to prepare nutritious meals if they have all the ingredients they need.
- The time required to prepare healthy meals can be reduced by using a shopping list and keeping a well-stocked kitchen.
- Knowing how to cope with symptoms related to the disease or side effects of medication can help persons with HCV infection feel better and eat a more healthy diet. *(See Chapter 5.)*
- Knowing how to prepare simple, healthy meals can help persons infected with HCV save food dollars and get the nutrients they need.

Some Factors That Affect the Foods People Choose

- what foods are available in their area
- the cost of food and how much money they have to spend
- the amount of time they have to shop and to prepare meals
- which foods are familiar
- likes and dislikes (their own, and those of their family)
- cooking skills
- discomforts due to illness

Tools and resources are available to help persons infected with HCV:

- The principles of CFGHE can be applied to the selection of processed and ready-to-eat foods to help people who have less time or energy for food preparation.
- See Resources for Chapter 8 for information on food budgeting, shopping, meal planning (including recipes and sample menus), and reading nutrition labels.
- See *Appendix G: Healthy Eating—Planning Tips* and *Appendix H: Low-Cost Nutritious Choices*.

Additional screening factors such as living environment (e.g. homelessness, home security, and access to a stove and refrigerator), income and expenses (e.g. evaluation of money available for food) and functional status (e.g. ability for self-care and stamina for shopping and cooking) can be linked to specific interventions that address problems (e.g. securing housing services, vouchers for food or support services for shopping or cooking). People at risk for malnutrition based on psychosocial or economic status should be referred to social service professionals for more complete evaluation and intervention.

Nutrition Labelling

Nutrition information on food package labels can help people select foods to meet healthy eating recommendations. Commencing in 2003, Canada has a new system of nutrition labelling that provides standardized information that is easier to find, easier to read and on more foods.

The nutrition information on food labels can help persons infected with HCV make informed food choices. For example, the new labels help to put the numbers in context by consistently showing what portion size the information is based on, and what percentage of the recommended daily intake (% Daily Value) each nutrient represents.

The nutrition information on food labels can help to increase or decrease intake of a particular nutrient; compare products more easily; determine the nutritional value of foods; and better manage special diets. The information includes **Nutrition Facts,** the **list of ingredients** and **nutrition claims**.

- Almost all prepackaged foods will have **Nutrition Facts** by 2006, providing information on Calories and 13 nutrients, including fat, carbohydrate, protein and sodium *(see Appendix I).*

- Some products may also carry **nutrition claims** such as "low fat" or "high fibre". Regulations specify the exact conditions for a food to qualify for these claims.
- New to some food labels are diet-related health claims. These types of nutrition claims reinforce the role of healthy eating as part of a lifestyle that can reduce the risk of developing a chronic disease, such as heart disease or cancer.
- Most packaged food must have an **ingredient list.** Ingredients in the food are listed by weight from most to least.

Key Messages to Guide Nutrition Labelling Education

- Nutrition Facts: easy to find, easy to read, and on more foods.
- Use Nutrition Facts, the list of ingredients and nutrition claims to make informed food choices.
- Nutrition Facts are based on a specific amount of food—compare this to the amount eaten.
- Use % Daily Value to see if a food has a lot or a little of a nutrient.

Source: <www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/labelling-etiquetage/key_messages_e.html>

(Nutrition labelling education materials, see Resources for this chapter.)

Food Safety

Persons infected with HCV need to be careful to avoid food-borne illness. A key strategy is to store and prepare food at home safely. One of the best practices is to wash hands often and well when handling food and cooking. (*See Appendix J.)*

For more information, consult…

- **Practice Essentials** for this chapter
- **Resources** for this chapter
- **Appendices G, H, I, J**

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<www.statcan.ca/Daily/English/020626/d020626a.htm>

Resources — Organizations and General Useful Resources

Organizations

American Liver Foundation
<www.liverfoundation.org/>

Canadian Association of Hepatology Nurses
<www.livernurses.org>

Canadian Association for the Study of the Liver
<www.lhsc.on.ca/casl/>

Canadian Hemophilia Society
<www.hemophilia.ca/en/0.0.html>

Canadian Liver Foundation
<www.liver.ca/english/index.html>

Dietitians of Canada
<www.dietitians.ca>

Health Canada – Hepatitis C information
<www.healthcanada.ca/hepc>

Hepatitis C Society of Canada
<www.hepatitiscsociety.com/home.htm>

Hepatitis Foundation International
<www.hepfi.org/index.html>

HepNet – The Hepatitis Information Network (Canadian)
<www.hepnet.com>

HepCNet – Hepatitis C Resources and Support
<www.hepcnet.net/index.html>

NIH – National Institute of Diabetes & Digestive & Kidney Diseases
(Chronic Hepatitis C: Current Disease Management)
<www.niddk.nih.gov/index.htm>

NIH – National Center for Complementary and Alternative Medicine
<nccam.nih.gov/index.htm>

US Centers for Disease Control and Prevention, National Center for Infectious Diseases
<www.cdc.gov/ncidod/diseases/hepatitis/c/index.htm>

General Useful Resources

Client handouts <www.dieteticsatwork.com> or <www.dietitians.ca/resources/index.html>

- *Helping You Feel Your Best: Nutrition Tips for People with Hepatitis C*
- *Dealing with Discomforts: Nutrition Tips for People with Hepatitis C*

How to locate a registered dietitian

- <www.dietitians.ca> — search "Find a Nutrition Professional"
- Call the local public health department, hospital or community health centre.
- Call the Consulting Dietitians Network at 1-888-901-7776.

Health Canada resources

Canada's Food Guide to Healthy Eating
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/food_guide_rainbow_e.html>

Using the Food Guide
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/using_food_guide_intro_e.html>

Food Guide Facts: Background for Educators and Communicators
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/food_guide_background_intro_e.html>

Canada's Physical Activity Guide to Healthy Active Living
<www.paguide.com> or 1-888-334-9769

The VITALITY Approach – A Guide for Leaders
<www.hc-sc.gc.ca/hppb/nutrition/pube/vitality/index.html>

Health Canada: nutrition labelling education resources (includes toolkit for educators)
<www.healthcanada.ca/nutritionlabelling>

Other key hepatitis C resources

Canadian Nurses Association: *Hepatitis C: A Nursing Guide*, CNA, 2002
<www.cna-aiic.ca/pages/education/hep_c_workshop/hep c - 2002.pdf>

Dietitians of Canada: *Needs Assessment of Nutritional Guidelines for Persons Infected with the Hepatitis C Virus*. Feedback from health care professionals, associations, and persons infected with HCV. Health Canada, March 2000

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National Institutes of Health: *Consensus Development Conference Statement*
Management of Hepatitis C: 2002, NIH: June 10–12, 2002 (Final Statement September 12, 2002)
<odp.od.nih.gov/consensus/cons/116/116cdc_intro.htm> or <consensus.nih.gov/cons/116/Hepc091202.pdf>

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Nutrient databases

Health Canada Canadian Nutrient Database: *Nutrient Value of Some Common Foods*
<www.hc-sc.gc.ca/food-aliment/ns-sc/nr-rn/surveillance/e_nutrient_value_of_some_common_.html>

USDA: Search the USDA National Nutrient Database for Standard Reference
<www.nal.usda.gov/fnic/cgi-bin/nut_search.pl>

Evaluating internet-based health information

National Center for Complementary and Alternative Medicine: *10 Things to Know About Evaluating Medical Resources on the Web*, NIH <nccam.nih.gov/health/webresources/>

Resources — by Chapter

Introduction Resources

Population health model and its application to nutritional well-being

- Federal, Provincial and Territorial Advisory Committee on Population Health: *Strategies for Population Health: Investing in the Health of Canadians*. Cat. No. H39-316/1994E. Ottawa: Minister of Supply and Services Canada, 1994
- Joint Steering Committee Responsible for the Development of a National Nutrition Plan for Canada. *Nutrition for Health: An Agenda for Action*. Ottawa: Joint Steering Committee, 1996 <www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/nutrition_health_agenda_e.html>

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- Health Canada: *Nutrition for a Healthy Pregnancy: National Guidelines for the Childbearing Years*, 1999 <www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/national_guidelines_int_e.html>
- American Dietetic Association: *Chronic Kidney Disease Medical Nutrition Therapy Protocol*, 2002
- American Society for Enteral and Parenteral Nutrition: Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *J Parenter Enteral Nutr* 2002; 26(1 suppl) <www.nutritioncare.org/publications/2002guidelines.pdf>
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Chapter 1 Resources

American Liver Foundation: *Diet & Your Liver*
<64.227.163.135/cgi-bin/dbs/articles.cgi?db=articles&uid=default&ID=1022&view_records=1>

Canadian Liver Foundation National Hepatitis C Education Program: Hepatitis C: medical information update. *Can J Public Health* 2000; 91(suppl 1):S4–S9

College of Family Physicians of Canada: *Primary Care Management of Hep C* (Physician Desk Reference), 2002
<www.hc-sc.gc.ca/hppb/hepatitis_c/pdf/EnglishDeskRef.pdf>

Everson GT, Weinberg H: *Living with Hepatitis C: A Survivor's Guide*. New York: Hatherleigh Press, 1999

Health Canada: *Hepatitis C Information for Health Professionals*
<www.hc-sc.gc.ca/hppb/hepatitis_c/pdf/hepcInformation.pdf>

Health Canada: *Hepatitis C: Get the Facts*
<www.hc-sc.gc.ca/hppb/hepatitis_c/pdf/hepcGetFacts.pdf>

Heathcote J, Yim C, Thai Q et al: *Hepatitis C: Everything You Need to Know*. Canadian Medical Association, 2001

National Institute of Diabetes & Digestive & Kidney Diseases: *Chronic Hepatitis C: Current Disease Management.* NIH, September 2002 <www.niddk.nih.gov/health/digest/pubs/chrnhepc/chrnhepc.htm>

National Institutes of Health: *Consensus Development Conference Statement*
Management of Hepatitis C: 2002, NIH: June 10–12, 2002 (Final Statement September 12, 2002)
<consensus.nih.gov/cons/116/091202116cdc_statement.htm> or <consensus.nih.gov/cons/116/Hepc091202.pdf>

US Centers for Disease Control and Prevention: *Hepatitis C: What Clinicians and Other Health Professionals Need to Know* [online course based on recommendations for prevention and control of hepatitis C virus (HCV) infection and HCV-related chronic disease. *MMWR* 1998; 47:1–39
<www.cdc.gov/ncidod/diseases/hepatitis/C_Training/edu/default.htm>

Chapter 2 Resources

Healthy Eating

Appendix A: Healthy Eating Checklist, modified for persons with hepatitis C

Appendix B: Canada's Food Guide Principles

Dietitians of Canada: factsheets on Healthy Eating: The Basics
<www.dietitians.ca/english/factsheets/basics.html>
-Especially useful: *Fast Facts about Nutrition*; *5 Tips for Healthy Eating*; and *Make Your Move to Healthier Eating* (tips to deal with common challenges to eating well)

Dietitians of Canada: Eat Well, Live Well section
<www.dietitians.ca/eatwell>
-Includes *Your Nutrition Profile*, *Meal Planner* and *Virtual Kitchen tour*, nutrition information and tools to compare food choices to recommendations, and personalized advice for making improvements.

Everson GT, Weinberg H: *Living with Hepatitis C: A Survivor's Guide*. New York: Hatherleigh Press, 1999

Health Canada: *Canada's Food Guide to Healthy Eating*. Ottawa, 1992
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/food_guide_rainbow_e.html>

Health Canada: *Using the Food Guide*
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/using_food_guide_intro_e.html>

Health Canada: *Food Guide Facts: Background for Educators and Communicators*. Ottawa: Minister of Supply and Services Canada, 1992
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/food_guide_background_intro_e.html>
-A series of useful fact sheets for health professionals who use the food guide for counselling and educational programs. Provides practical information and real-life examples that help communicate the key concepts and features of the food guide.

U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition: *Tips for the Savvy Supplement User: Making Informed Decisions and Evaluating Information*, January 2002
<www.cfsan.fda.gov/~dms/ds-savvy.html>

Vegetarian Information and Food Guides

American Dietetic Association, Dietitians of Canada: *Manual of Clinical Dietetics*, 6th ed. ADA and DC, October 2000 (Table 10.3: Daily Food Guide for Vegetarians, p.161; and Table 10.7: Vegetarian Diet Meal Planning Guidelines, p.172)

American Dietetic Association: *Vegetarian Nutrition Fact Sheets*. Vegetarian Nutrition Dietetic Practice Group of the American Dietetic Association
<www.vegetariannutritiondpg.org/fact.htm>

Dietitians of Canada: three factsheets on vegetarian eating
<www.dietitians.ca/english/factsheets/vegetarian.html>

Melina V, Davis B, Harrison V: *Becoming Vegetarian: The Complete Guide to Adopting a Healthy Vegetarian Diet*. Summertown, TN: The Book Publishing Co., 1995

Healthy Body Weight and Active Living

Appendix C: Summary of Physical Activity Considerations

Dietitians of Canada: *Healthy Body Quiz*
<www.dietitians.ca/english/healthy/bod_index.html>
-Includes a Body Mass Index calculator, physical activity quiz and personalized tips for active living.

Health Canada: Canadian Guidelines for Weight Classification
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/weights_e.html>
-includes the background document, "A Review of Weight Guidelines"

Health Canada, Canadian Society for Exercise Physiology: *Canada's Physical Activity Guide to Healthy Active Living*. Ottawa, 1998
<www.paguide.com> or 1-888-334-9769

Health Canada Body Mass Index (BMI) chart
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/bmi_chart_e.pdf>

Health Canada: *The VITALITY Approach: A Guide for Leaders*
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/vitality_approach_e.html>

Chapter 3 Resources

Appendix D: Quick Protein Check

Appendix E: Guidelines for Food Selection with Sodium Restriction

American Dietetic Association, Dietitians of Canada: *Manual of Clinical Dietetics*, 6th ed. ADA and DC, October 2000 (Chapter 29: Liver Disease and Chapter 41: Liver Transplant)

American Liver Foundation: *Diet & Your Liver*
<64.227.163.135/cgi-bin/dbs/articles.cgi?db=articles&uid=default&ID=1022&view_records=1>

Canadian Liver Foundation: *Nutrition and the Liver*. Medical Information Sheet INF-18-07-96E

Everson GT, Weinberg H: *Living with Hepatitis C: A Survivor's Guide*. New York: Hatherleigh Press, 1999

HepNet – The Hepatitis Information Network (Canadian): *Eating Right: and Drinking Too*
<www.hepnet.com/charge/chap8.html>
-Diet and liver disease, Making healthful food choices, Coping with common eating problems

Palmer M: *Diet and Hepatitis C*. American Liver Foundation, 1997

Wolever T, Barbeau M-C, Charron C et al: Guidelines for the Nutritional Management of Diabetes Mellitus in the New Millennium: A Position Statement by the Canadian Diabetes Association. *Can J Diabetes Care* 2000; 23(3):56–69
<www.diabetes.ca/Section_Professionals/nutriguide.asp>

Chapter 4 Resources

American Dietetic Association, Dietitians of Canada: *Manual of Clinical Dietetics*, 6th ed. ADA and DC, October 2000 (Chapter 1: Nutrition Assessment of Adults)
-includes Sample Subjective Global Assessment Measurement Protocol (Fig 1.4)

Health Canada Body Mass Index (BMI) chart
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/bmi_chart_e.pdf>

Chapter 5 Resources

Appendix C: Summary of Physical Activity Considerations

Appendix F: Managing Common Discomforts and Treatment Side Effects

Everson GT, Weinberg H: *Living with Hepatitis C: A Survivor's Guide*. New York: Hatherleigh Press, 1999

Heathcote J, Yim C, Thai Q et al: *Hepatitis C: Everything You Need to Know*. Canadian Medical Association, 2001

Schering Canada Inc.: Canadian Association of Hepatology Nurses (ed): *Knowledge is Power: Take Control of Hepatitis C*, 2000
<www.hepnet.com/hepc/power.html>

Chapter 6 Resources

Dietitians of Canada: factsheets and resources on vitamins and supplements
<www.dietitians.ca/english/factsheets/index.html>
-Includes the resource manual, *A Health Professional's Guide to Antioxidants, B Vitamins, Calcium and Other Bone Health Nutrients*

Everson GT, Weinberg H: *Living with Hepatitis C: A Survivor's Guide*. New York: Hatherleigh Press, 1999

Health Canada, Therapeutic Products Programme: *Drug Product Database*
<www.hc-sc.gc.ca/hpb-dgps/therapeut/htmleng/dpd.html>
-Information concerning Canadian nutritive supplements

Health Canada: *Canadian Adverse Drug Reaction Monitoring Program Guidelines for the Voluntary Reporting of Adverse Drug Reactions by Health Professionals*
<www.hc-sc.gc.ca/hpb-dgps/therapeut/zfiles/english/guides/adr/adr_guideline_e.html>

Heathcote J, Yim C, Thai Q et al: *Hepatitis C: Everything You Need to Know*. Canadian Medical Association, 2001

Mayo Clinic <www.mayoclinic.com>

Natural Medicines Comprehensive Database
<www.naturaldatabase.com>
-available with subscription

Tyler VE: *The Honest Herbal: A Sensible Guide to the Use of Herbs and Related Remedies*, 3rd ed. Binghamton, NY: Pharmaceutical Products Press, 1993

National Center for Complementary and Alternative Medicine: *Hepatitis C: Treatment Alternatives*, NIH, May 2000
<nccam.nih.gov/health/hepatitisc/index.htm> or <nccam.nih.gov/health/hepatitisc/hepatitisc.pdf>

U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition: *Tips for the Savvy Supplement User: Making Informed Decisions and Evaluating Information*, January 2002
<www.cfsan.fda.gov/~dms/ds-savvy.html>

US Food and Drug Administration, Center for Food Safety and Applied Nutrition: Dietary Supplements website
<www.cfsan.fda.gov/~dms/supplmnt.html>

US National Academy Press: Dietary Reference Intake reports
<search.nap.edu/nap-cgi/naptitle.cgi?Search=dietary+reference+intakes>

US National Institutes of Health Office of Dietary Supplements: IBIDS—International Bibliographic Information on Dietary Supplements
<odp.od.nih.gov/ods>

Chapter 7 Resources

Appendix A: Healthy Eating Checklist, modified for persons with hepatitis C

Dietitians of Canada: *Healthy Eating Is Especially Important When You Are HIV-Positive*
<www.dietitians.ca/english/factsheets/e1997_08.html>

Everson GT, Weinberg H: *Living with Hepatitis C: A Survivor's Guide*. New York: Hatherleigh Press, 1999

Health Canada: *Violence Issues: An Interdisciplinary Curriculum Guide for Health Professionals*. Ottawa: Minister of Supply and Services, 1995

National Institute on Alcohol Abuse and Alcoholism: *How to Cut Down on Your Drinking*
<www.niaaa.nih.gov/publications/handout.htm>

Murphy S: *Healthy Eating Makes a Difference: A Food Resource Book for People Living with HIV.* Canadian Hemophilia Society and Health and Welfare Canada, in conjunction with National AIDS Strategy, 1993 (rev 1996)

US Centers for Disease Control and Prevention, Division of HIV/AIDS Prevention: *Frequently Asked Questions and Answers About Coinfection with HIV and Hepatitis C Virus*
<www.cdc.gov/hiv/pubs/facts/HIV-HCV_Coinfection.htm>

Wolever T, Barbeau M-C, Charron C et al: Guidelines for the Nutritional Management of Diabetes Mellitus in the New Millennium: A Position Statement by the Canadian Diabetes Association. *Can J Diabetes Care* 2000; 23(3):56–69
<www.diabetes.ca/Section_Professionals/nutriguide.asp>

Aboriginal Food Guides

- Refer to local food guide if available (contact Regional Nutritionist with First Nations and Inuit Health Branch)
- Consult *Canada's Food Guide to Healthy Eating* modified to include more native traditional foods

Chapter 8 Resources

Appendix G: Healthy Eating — Planning Tips

Appendix H: Low-Cost Nutritious Choices

Appendix I: Standard Nutrition Facts Label

Appendix J: Tips for Safe Food Handling

Canadian Partnership for Consumer Food Safety Education: FightBAC™
<www.canfightbac.org>
-Food safety information and materials

Consumers' Association of Canada: *Shop Smart*
<www.consumer.ca/pdf/food.pdf>
-Includes easy-to-read tips on how to shop smart and eat well, and information on how to store and prepare foods from each food group.

Dietitians of Canada: *Healthy Eating is in Store for You*
<www.healthyeatingisinstore.ca> (effective May 2003)
-nutrition labelling education campaign

Dietitians of Canada: factsheets on Healthy Eating: Meal Planning
<www.dietitians.ca/english/factsheets/meal_planning.html>
-*Eating Value For Your $* (a factsheet on food budgeting that offers money-saving tips for planning and preparing nutritious meals)
-*Handle with Care* (food safety tips)

Dietitians of Canada: *Senior Friendly™ Factsheets*
<www.dietitians.ca/resources/senior_friendly_factsheets.htm> or <www.dietitians.ca/resources/seniorfriendly11.pdf>
-Includes factsheets on meal planning, shopping and cooking

Health Canada: Nutrition Labelling Toolkit for Educators, 2003
<www.hc-sc.gc.ca/hpfb-dgpsa/onpp-bppn/labelling-etiquetage/education_e.html>

Heppo Recipe Exchange
<www.hepcnet.net/recipes/recipeindex.html>
-Recipes submitted by other persons infected with HCV; not specifically "HepC healthy" unless noted.

National Heart, Lung, and Blood Institute: *DASHing with Less Salt*
<www.nhlbi.nih.gov/health/public/heart/hbp/dash/dashing.htm>
-Although focused on reducing hypertension, these tips for adopting a low sodium eating pattern and sample menus and recipes may be useful for hepatitis C patients.

USDA Center for Nutrition Policy and Promotion: *Recipes and Tips for Healthy, Thrifty Meals*
<www.pueblo.gsa.gov/cic_text/food/rec-thrifty/recipes.htm> or <www.pueblo.gsa.gov/cic_text/food/rec-thrifty/thriftym.pdf>
-Includes tips for planning meals, shopping, best buys for cost and nutrition, healthy cooking, and food safety, as well as recipes and a sample menu.

Glossary of Terms and Acronyms

Term	Meaning
$25(OH)D_3$	liver-activated vitamin D: 25-dihydroxycholicalciferol
AAA	aromatic amino acids
AI	Adequate Intake (one of the four categories of DRI values)
ALT	alanine aminotransferase, a liver enzyme; elevated in blood when liver cells are damaged
Acceptable Macronutrient Distribution Range	-a range of intakes for a particular energy source that is associated with reduced risk of chronic disease while providing adequate intakes of essential nutrients -expressed as a percentage of total energy intake
acute	a short-term, intense health effect
acute hepatitis c	inflammation of the liver due to HCV infection, that resolves within 6 months of onset
alternative medicine	medical and health care practices that are not an integral part of conventional (Western) medicine; practices usually used to promote well-being or treat health conditions instead of conventional medical practices (e.g. acupuncture, homeopathy, herbs, therapeutic massage, traditional oriental medicine)
anorexia	lack of appetite
ascites	accumulation of fluid in the abdominal cavity
AST	aspartate aminotransferase, a liver enzyme; elevated in blood when liver cells are damaged
BCAA	branched-chain amino acids (valine, leucine, isoleucine)
BEE	basal energy expenditure
BMI	Body Mass Index
bile	fluid made by the liver to help digest foods containing fat and cholesterol
CAM	complementary or alternative medicine; medical and health care practices that are not an integral part of conventional (Western) medicine
CBC	complete blood cell count
CFGHE	*Canada's Food Guide to Healthy Eating*
CGHE	*Canada's Guidelines for Healthy Eating*
CHI	creatinine height index
cholestasis	inability of the liver to secrete bile into the small intestine to aid in the digestion of fats
chronic hepatitis c	persistent liver inflammation in patients with HCV infection; characterized by abnormal levels of liver enzymes; identified by HCV RNA 6 months after acute infection
cirrhosis	widespread disruption of normal liver structure (scarring of the liver); a process in which liver cells are damaged or killed and replaced with scar tissue
compensated cirrhosis	the liver is heavily scarred but can still function normally -cirrhosis without major life-threatening complications (ascites and/or encephalopathy)
complementary medicine	medical and health care practices that are not an integral part of conventional (Western) medicine; used in conjunction with or in addition to conventional medicine to further promote health (e.g. use of herbal remedies to ease side effects of conventional drugs)
DHA	decosahexaenoic acid
DRIs	Dietary Reference Intakes: expanded nutrient recommendations being developed jointly by the US and Canada
decompensated cirrhosis	the liver is extensively scarred and unable to function normally -cirrhosis with major life-threatening complications (ascites and/or encephalopathy)
diuretic	medication that causes the kidneys to excrete more sodium and water into the urine
EAR	Estimated Average Requirement (one of the four categories of DRI values)
EER	Estimated Energy Requirement
EFA	essential fatty acids
EIA	enzyme immunoassay
EPA	eicosapentaenoic acid
ESLD	end-stage liver disease
edema	fluid build-up in the tissues, usually the feet, legs or back
Estimated Energy Requirement	average energy intake predicted to maintain energy balance in a healthy adult of defined age, gender, weight, height and level of physical activity, consistent with good health
fibrosis	development of fibrous scar tissue
fulminant hepatic failure	a rare and life-threatening condition resulting from acute and severe liver injury that destroys the majority of hepatocytes
gluconeogenesis	formation of sugar from protein or fat when insufficient carbohydrate is available

glycemic index	the rise in blood glucose elicited by a carbohydrate food expressed as a percentage of the rise in blood glucose that would occur if the same individual ingested an equal amount of carbohydrate from white bread or glucose
HAART	highly activated antiretroviral therapy
HCC	hepatocellular carcinoma; liver cancer
HCV	hepatitis C virus
HCV-RNA	the genetic material of the virus that coordinates viral reproduction and protein synthesis
HE	hepatic encephalopathy
HIV	human immunodeficiency virus
hemochromatosis	congenital error in iron metabolism that causes increased iron deposition in tissues; results in liver cirrhosis
hemosiderosis	iron deposits in the tissues
hepatic	anything relating to the liver
hepatic encephalopathy	a reversible condition of impaired mental function resulting from build-up of toxins commonly due to gastrointestinal bleeding, infection or electrolyte imbalances
hepatitis	inflammation of the liver
hepatitis C	a liver disease caused by the hepatitis C virus, which circulates in the blood of persons who have the disease; spread by contact with the blood of an infected person, most commonly through injection drug use
hepatocellular carcinoma	the most common primary malignant liver tumor; liver cancer
hepatocyte	liver cell
hepatotoxic	toxic to the liver
hypokalemia	low blood levels of potassium
hyponatremia	low blood levels of sodium
INR	International Normalized Ratio
incidence	the number of new disease cases reported in a population over a certain period of time
jaundice	condition in which the whites of the eyes go yellow and in more severe cases the skin also turns yellow; caused by the yellow pigment (bilirubin) that is normally disposed of by the liver; often a symptom of viral hepatitis infection
LCT	long-chain triglycerides
MCT	medium-chain triglycerides
mortality	the number of deaths in a given time or place
myalgias	muscle aches
NPO	nothing by mouth
necrosis	localized tissue death
oxidative stress	imbalance between oxidants (e.g. free radicals) and antioxidants; can lead to cell damage
PCT	porphyria cutanea tarda
PEM	protein–energy malnutrition, also known as protein–calorie malnutrition
PUFA	polyunsaturated fatty acids
portal hypertension	elevation of blood pressure in the liver due to obstruction of blood flow through the liver
portal vein	vein bringing blood from the intestines to the liver, where nutrients will pass to the liver and toxins will be filtered out
prevalence	the number of disease cases (new and existing) within a population at a given time
RDA	Recommended Dietary Allowance (one of the four categories of DRI values)
RIBA	recombinant immunoblot assay
R/Q	Respiratory Quotient
SGA	Subjective Global Assessment
steatohepatitis	fatty deposits in the liver (fatty liver) accompanied by inflammation
steatorrhea	fat malabsorption due to inadequate amounts of bile
steatosis	fatty deposits in the liver (fatty liver)
TPGS	tocopherol polyethylene glycol solution
TPN	total parenteral nutrition
UBW	usual body weight
UL	Tolerable Upper Intake Level (one of the four categories of DRI values)
variceal hemorrhage	rupturing of dilated veins in the esophagus and stomach in someone with cirrhosis of the liver; results in vomiting of blood, with or without passage of black bowel movements
varices	stretched and weakened blood vessels
vertical transmission	transmission of an infection from mother to child at birth
viral load	the concentration of virus in the blood
virus	tiny organism that multiplies within cells and causes disease such as chickenpox, measles, mumps, rubella, pertussis and hepatitis

Appendices

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Note: These Appendices are intended as resources for the health care provider to aid in offering appropriate advice to persons infected with HCV. Two patient handouts are also available at <www.dieteticsatwork.com> or <www.dietitians.ca/resources/index.html>:

- *Helping You Feel Your Best: Nutrition Tips for People with Hepatitis C*
- *Dealing with Discomforts: Nutrition Tips for People with Hepatitis C*

Appendix A
Healthy Eating Checklist for Persons with Hepatitis C

- This checklist can be used along with *Canada's Food Guide to Healthy Eating* and *Appendix B* to assess the quality of your patients' eating pattern in a general way.
- It is not intended as a handout. The questions and responses are provided as a guide for the health care provider; specific advice and wording should be tailored to the individual patient.
- More specialized advice would be needed for patients with advanced liver disease.

QUESTIONS TO ASK		PATIENT RESPONSE	
		YES	NO *(and suggested advice)*
Regular meals	Do you eat regularly, at least every 3 to 4 hours during the day?		Try to eat regular meals and snacks. It will boost your energy level and ward off nausea.
Balance	Do you eat at least the minimum number of servings from each food group every day? *(What groups are missing?)* ♦ **5** to 12 Grain Products ♦ **5** to 10 Vegetables & Fruit ♦ **3** to 4 Milk Products ♦ **2** to 3 Meat & Alternatives		All four food groups are needed for good health. They all provide different nutrients. [A patient who avoids a food group entirely should be referred to a registered dietitian.] Try to include a Grain Product and Vegetable or Fruit with most meals or snacks.
	Grain Products: Are most of your choices whole grain or enriched? Vegetables & Fruit: Do you include dark green or orange vegetables or orange fruit? Milk Products: Do you choose lower fat milk products? Do you include milk to get calcium plus vitamin D? Meat & Alternatives: Do you choose leaner, nutrient-packed meats, poultry and fish, as well as dried peas, beans and lentils?		These are the "every day" foods that your body needs to be healthy. Grain Products and Vegetables & Fruit should cover about two thirds of your plate. Let's try to figure out what your meals and snacks should look like over the next few days to balance out what you have eaten recently.
Variety	Did you choose a variety of foods from each food group?		Eating a variety of foods from each food group provides the many nutrients your body needs to function well and help your liver heal. Variety also makes healthy eating more interesting. For example, try a new vegetable or fruit every few weeks.
Moderation	Do you focus on foods from the four food groups and limit Other Foods which tend to be higher in sugar and fat? Do you enjoy Other Foods in small amounts to enhance the flavour of your foods and beverages? Are your meals and snacks low or high in fat? What makes them so? Do you choose foods that are moderate in salt, and avoid adding salt in cooking and at the table?		Other Foods should not replace foods from the four food groups but can be enjoyed in moderation. We all need some fat in our diets. Fat gives essential fatty acids and helps absorb certain vitamins. Fat also adds taste to food and keeps us feeling full after a meal. Each food group has higher and lower fat choices. Make lower fat choices from each food group more often (e.g. a whole wheat roll is lower in fat than a croissant). Choose salty foods less often. -Focus on fresh foods and try lemon juice as a salt substitute. -Prepared foods often contain a lot of sodium. -Restaurant and "fast food" meals also tend to be high in sodium. -Check food labels for information on sodium content. [Sodium may need further restriction if ascites is present.]
Fluids	Do you drink fluids during the day (at least 6–8 glasses, including water, milk, juice, milkshakes, liquid nutrition supplements…)?		Drinking fluids is an important part of a healthy diet. Avoid letting yourself get thirsty.

Healthy Eating Checklist *(cont'd)*

QUESTIONS TO ASK		PATIENT RESPONSE	
		YES	NO *(and suggested advice)*
Alcohol	Do you avoid all drinks that contain alcohol (beer, wine, coolers, mixed drinks, hard liquor, etc.)? [Can be asked in a non-judgemental way, such as "How many drinks do you consume in a day/week/month?"]		Alcohol is damaging to the liver; avoiding alcohol can help protect the liver against further damage and slow the progression of HCV disease. At present, there is no evidence for a safe intake level, so the best advice is to avoid alcohol completely.
Complementary or Alternative Medicine	Which supplements do you use? If you use vitamin supplements, what dosage do you take? If you use herbal products, are they safe for the liver?		Safety is the first concern. Avoid herbal products that are known to be toxic to the liver or are of questionable safety. [Refer to list in Chapter 6.] Avoid herbal products if on antiviral medications. Choose foods as your safest sources of antioxidants.
Exercise	Were you active today? Are you active for 30 to 60 minutes on most days?		Activity can help you have more energy, relieve stress, relieve discomforts, maintain a healthy weight. Try to build 10-minute blocks of activity into your daily routine. Aim for low-impact exercises such as walking or swimming.
Enjoyment	Did you enjoy eating today? Are you free from discomforts that keep you from eating well?		Eating should be a pleasure. There are things you can do to help cope with discomforts from the hepatitis C or side effects of treatment. [Offer the suggestions in Appendix F.] [Refer patients with extended poor appetite to a registered dietitian.]

Appendix B
Canada's Food Guide Principles

Grain Products	**5 to 12 servings every day**
Foods that give energy ♦ Choose whole grains such as rolled oats, whole wheat, bran, oat bran and barley. ♦ Limit the amount of butter, margarine, oil, etc., you put on bread and pasta.	***A serving is...*** ♦ 1 slice of bread ♦ ½ bagel ♦ ½ cup of cooked rice or pasta
Vegetables & Fruit	**5 to 10 servings every day**
Foods that protect your health ♦ Dark green- and orange-coloured vegetables and fruit are the best choices. ♦ Fresh, frozen or canned are all healthy choices.	***A serving is...*** ♦ 1 medium size vegetable or fruit ♦ ½ cup of berries ♦ ½ cup of vegetable juice or fruit juice ♦ 1 cup of green salad
Milk Products	**3 to 4 servings every day**
Foods for strong bones and teeth ♦ Choose lower fat milk products, such as skim or 1% milk. ♦ Milk is the richest source of calcium and one of the few sources of vitamin D.	***A serving is...*** ♦ 1 cup of milk ♦ 2 slices or a 50-gram piece of cheese *(same size as two thumbs together)* ♦ 3/4 cup of yogurt ♦ 1/3 to 2/3 of a small can of salmon or sardines (with bones)
Meat & Alternatives	**2 to 3 servings every day**
Foods for building healthy muscles ♦ Choose lean meats and cook in a healthy way (boiling, baking, stir-frying). ♦ Cooked or canned dried beans, peas and lentils, as well as eggs, are healthy and low-cost choices. ♦ Processed meats are high in fat and salt. Choose them less often.	***A serving is...*** ♦ 50 to 100 grams of beef, chicken, pork, fish *(about the size of a deck of cards)* ♦ 1 to 2 eggs ♦ ½ to 1 cup of cooked or canned dried beans ♦ 2 tablespoons of peanut butter
Other Foods	
A broad range of food items that do not belong in one of the four food groups ♦ These foods can add to the enjoyment of healthy eating. ♦ Some of these foods are higher in fat, sugar or calories. These should be chosen less often. ♦ Fats and oils are important sources of essential fatty acids, and margarine provides vitamin D. ♦ Everyone needs plenty of fluids every day. ♦ Limit caffeine foods and drinks (coffee, tea, chocolate, colas) to no more than 4–5 servings each day.	

Food Sources of Antioxidants

Vitamin C	kiwi, strawberries, citrus fruits, broccoli, cauliflower, Brussels sprouts, peppers, potatoes, tomatoes
Vitamin E	vegetable oils, flax, wheat germ, nuts, seeds, avocado
Selenium	Brazil nuts, whole grains, wheat germ, bran, fish, meat, poultry, eggs, beans
Carotenoids	carrots, cantaloupe, squash, pumpkin, sweet potatoes, tomatoes, yams, dark leafy greens

Appendix C
Summary of Physical Activity Considerations

Physical Activity Type	Examples	Safety Tips*
Endurance -continuous activities for the heart, lungs and circulatory system	Light to moderate activities: ▪ walking ▪ swimming ▪ bicycling ▪ dancing ▪ square dancing ▪ low-impact aerobics ▪ water aerobics ▪ yard and garden work	**Goal:** 15 to 30 minutes, 3 to 5 days a week Use the **FITT** acronym: ▪ **FREQUENCY**: Begin at 3 times per week, progress to 4 or 5 times per week. ▪ **INTENSITY** (effort): Avoid overexertion. The **"talk test"** can be used as a simple check (if you cannot carry on a conversation, you should slow down.) ▪ **TIME**: Attempt 15 minutes, even if it means slowing down. Rest if needed. Increase the length of activity gradually, to a maximum of 30 minutes. ▪ **TYPE**: Focus on low-impact activities that use large muscle groups. Start with a brief warm-up (10 to 15 minutes), follow by short cool-down (10 to 15 minutes).
Flexibility -gentle reaching, bending and stretching activities to keep muscles relaxed and joints mobile	▪ mopping the floor ▪ gardening ▪ vacuuming ▪ stretching exercises (range of motion or static stretching of major muscle groups) ▪ T'ai Chi ▪ dance	▪ Start with 5 minutes of light activity. ▪ Move slowly and smoothly without bouncing or jerking. ▪ Aim for a stretched, relaxed feeling that does not hurt. Do not overstretch. ▪ Breathe regularly and do not hold your breath.
Strength -activities against resistance to strengthen muscles and bones and improve posture	A variety will exercise the arms, mid-section and legs. ▪ pelvic tilt ▪ shoulder shrugs ▪ abdominal tightening ▪ wall push-ups ▪ raking and carrying leaves	▪ Start with 5 minutes of light endurance activity and stretching. ▪ Breathe regularly and do not hold your breath.

*A general safety precaution is to check with a doctor before starting an exercise program.

Tips for Building Physical Activity into the Daily Routine

- Avoid being inactive for long periods, like watching TV. Get up often from the couch and stretch and bend for a few minutes.
- Do the activities you are doing now, more often.
- Walk whenever you can. Get off the bus early, use the stairs instead of the elevator, leave the car at home and walk to the grocery store.
- Start with a 10-minute walk, and then gradually increase the time.
- Play actively with your children.
- Observe a physical activity class to see if you want to try it.
- Try one class to start; you do not have to make a long-term commitment.
- Find out about walking and cycling paths, swimming pools and skating rinks nearby, and use them.

Adapted from *Canada's Physical Activity Guide to Healthy Active Living* <www.paguide.com>

Appendix D
Quick Protein Check

Example: 70-kg person Daily Protein Needs: 1.2–1.5 grams per kg x 70 kg = 84–100 grams	
Foods Consumed	**Protein Content (g)**
breakfast: ½ cup milk ½ cup juice 1 cup cereal ½ banana	 4 - 4 -
snack: 1 pear 4 crackers	 - 2
lunch: 1 cup milk 3 oz chicken 2 slices bread ½ cup vegetable sticks ¾ cup yogurt	 8 21 4 2 8
snack: 1 cup juice 1 slice bread 1 tsp. jam	 - 2 -
supper: 1 cup milk 3 oz pork chop ½ cup applesauce 1 cup rice ½ cup vegetables	 8 21 - 4 2
TOTAL	**90**

Protein Content of Some Common Foods

Food Choice	Amount	Protein Content (g)
Animal sources		approx 7 g/oz
Meat, poultry or fish	90 g (3 oz)	21
Egg	1	6
Milk	250 mL (1 cup)	8
Yogurt	175 mL (3/4 cup)	8
Hard cheese	30 g (1 oz)	7
Cottage cheese	50 mL (1/4 cup)	7
Plant sources		
Fortified soy beverage	250 mL (1 cup)	5–9
Soy cheese	30 g (1 oz) slice	6
Nut butters	30 mL (2 Tbsp)	3–5
Bread	1 slice	2
Cereal, pasta, rice	125 mL (1/2 cup)	2
Vegetables	125 mL (1/2 cup)	1–2

Data source: Health Canada Canadian Nutrient Database: *Nutrient Value of Some Common Foods* <www.hc-sc.gc.ca/food-aliment/ns-sc/nr-rn/surveillance/e_nutrient_value_of_some_common_.html>

Appendix E
Guidelines for Food Selection with Sodium Restriction

2000 mg sodium (87 mmol)	1000 mg sodium (44 mmol)
Eliminate processed and prepared foods and beverages that are high in sodium.	Eliminate processed and prepared foods and beverages that are high in sodium
Eliminate all salt and high-sodium products during food preparation and at the table.	Omit salt- and sodium-containing products during food preparation and at the table.
Limit milk and milk products to 480 mL (16 oz) daily.	Limit milk and milk products to 480 mL (16 oz) daily.
Check labels of canned and instant products for sodium content and replace with low-sodium versions when available.	Omit the following regular items: canned foods prepared with sodium, cheeses, margarine and salad dressings. Check the label to find low-sodium or salt-free varieties of these foods.
	Omit frozen foods prepared with sodium, deli foods and fast foods.
	Limit breads baked with added salt to two servings per day.

Notes:
Diets containing <2000 mg/day of sodium are difficult to implement on an outpatient basis and may therefore result in non-compliance or exacerbation of malnutrition. Special low-sodium food products are a key part of such diets; however, they can be expensive and unpalatable.

Source:
American Dietetic Association, Dietitians of Canada: *Manual of Clinical Dietetics*, 6th ed. ADA and DC, 2000 (Chapter 68: Sodium-Restricted Diet)

Examples of High Sodium Foods and Ingredients

- canned or dehydrated regular soups
- canned vegetables and vegetable juices
- cured meats (bacon, sausage, ham, lunchmeats)
- prepared ready-to-eat meals
- frozen meals
- commercially prepared potato, rice and pasta mixes
- processed cheeses
- salty snacks (chips, pretzels, popcorn, salted nuts)
- pickled foods (sauerkraut, pickles, olives)
- snack foods made with instant soup mixes or processed cheese
- condiments such as mayonnaise and ketchup
- salt, garlic salt, onion salt, seasoning salt
- soy sauce, monosodium glutamate (MSG)

Appendix F
Managing Common Discomforts and Treatment Side Effects

Symptom or Side Effect	Suggestions for Your Patients
Fatigue	♦ Stock up on healthy, basic, easy-to-prepare foods when you are feeling well. ♦ When you are cooking, make extra food and freeze it. ♦ Have a few purchased ready-made frozen meals on hand. ♦ Have prepared snacks on hand. ♦ Keep liquid nutrition supplements on hand. ♦ Ask friends and family members to help you make meals.
Lack of appetite or Feeling full quickly	♦ Eat smaller portions more often. ♦ Try different tastes to stimulate your appetite: bitter, sour, salty, sweet. ♦ Drink liquids separately from meals. ♦ Drink juice, milk or milkshakes instead of low-calorie fluids like tea, broth or coffee. ♦ Make the most of each mouthful. Even if you cannot eat much food, choose foods that are high in calories and protein. ♦ Do not use foods that are labelled "Light", "Lite", "Calorie-Reduced" or "Low-Calorie". ♦ Take advantage of times when your appetite is best. ♦ Use liquid nutrition supplements when you need to. ♦ Add ingredients to boost your nutrition (see list that follows). ♦ Do some mild exercise before eating. ♦ Check your weight regularly. See your dietitian if you have difficulty keeping weight on. See your doctor if the problem continues.
Nausea or vomiting	♦ Avoid having an empty stomach. Try to eat every few hours. ♦ Eat what you can. If a food appeals to you, give it a try (see list that follows). ♦ Eat the most when you feel hungry. When you feel better, focus on nutritious foods. ♦ Drink lots of fluids. Drink fluids separately from meals. ♦ Avoid citrus juices as the acid may irritate the stomach. ♦ Sip slowly on apple or grape juice, ginger ale, soda water, chicken broth, weak tea. Avoid using straws. ♦ Use liquid nutrition supplements. ♦ Learn to avoid your triggers, such as the smell, taste or even the thought of some foods. ♦ Keep well rested and avoid fatigue. ♦ Avoid high fat and fried foods; eat lower fat meats, poultry and fish; use skim or low fat milk products; try carbohydrate-rich foods such as fruit, fruit juice, breads, cereals, rice, potatoes. ♦ Check your weight regularly. See your dietitian if you have difficulty keeping weight on. See your doctor if the problem continues.
Diarrhea	♦ Eat smaller portions more often. ♦ Drink lots of fluids. ♦ Make eating a relaxed time. ♦ Consult a dietitian if losing weight. ♦ Consult a doctor if the problem continues (monitor electrolytes, screen for fat malabsorption).
Changes in taste	♦ Some foods with protein, red meat in particular, might taste bitter. ♦ Try chicken, fish, other protein foods such as beans, cheese, yogurt, tuna, eggs, peanut butter. ♦ Try meat cold or at room temperature. ♦ Speak with your doctor about a 3-month trial of zinc supplementation.
Changes in smell	♦ Changes in smell may result in an aversion to the smell of cooking or cooked food. ♦ Try serving foods cold or at room temperature. ♦ Turn on a kitchen fan while food is cooking and during the meal. ♦ Open windows when possible. ♦ Grill foods outside in the summer. ♦ Use microwave or cook-in boiling bags.

Additional Tips

Tips to Relieve Nausea or Vomiting	
If this appeals to you...	**Try...**
tart/sour	pickles, lemonade
earthy	brown rice, mushroom soup
crunchy	celery sticks, apples
bland	mashed potatoes
salty	chips, pretzels
soft	bread, noodles, macaroni
sweet	cake, sugary cereal
fruity	juice, fruity popsicles
wet	juice, fizzy drinks (ginger ale, cranberry juice and soda water)
dry	crackers

Tips for Maximizing Nutrition

Include ingredients that add to the nutrition of the foods you are able to eat. For example:

- Add powdered milk to regular milk, milkshakes, even casseroles, soups, eggs, mashed potatoes, hot cereal and puddings. Try adding ¼ cup of powdered milk to 1 glass of regular milk.
- Spread peanut butter on breads, tortillas, waffles, pancakes and fruit.
- Add cooked beans or hard-boiled eggs to soups, casseroles and pasta that already contain cheese or meat.
- Melt cheese on sandwiches, hamburgers, vegetables, rice or noodles.
- Try products such as instant breakfast powders, liquid nutrition supplements and special puddings.

Appendix G
Healthy Eating — Planning Tips

A. Set a Food Budget

- Determine how much money is available to spend on food for the month.
- Look for ways to save money on other non-essential expenses in the household to leave enough money for food.

B. Plan Meals

- **Plan the meals for the week.**
  Make sure to plan at least the minimum number of servings from each food group every day.
  Include 3 meals and 2 to 3 snacks per day. Include foods from at least 3 of the 4 food groups at each meal.
- **Balance your meals.**
  Grain Products and Vegetables & Fruit should cover about two thirds of your plate.
  High-protein foods (meat, poultry, fish, eggs) should cover the other third of the plate.
- **Think about variety and moderation.**
  Variety will ensure you are getting all the nutrients you need.
  Choose lower fat and higher fibre foods from each food group more often.
  Choose Other Foods that are lower in sugar and fat less often.
- **Organize menu ideas.**
  Make a written list of menu items to refer to when you are out of ideas or thinking of something to make with food items that are on special.
  Keep well stocked with food basics such as vegetables, soups, canned fish, rice, pasta and baked beans.
- **Make a shopping list.**
  Keep a running tab of foods as you run out of them.
  Find out what foods are on special and pull out any coupons you have.
  Organize the list by food group (Grain Products; Vegetables & Fruit; Milk Products; Meat & Alternatives; Other Foods) or by the layout of the grocery store you use most often.

C. Shop Carefully

- **Use the shopping list.**
  Avoid buying things you do not need, missing items and making extra shopping trips.
  Be flexible enough to adjust the list and menu plan if you discover something is more expensive than you thought or notice something else on special.
- **Look for low-cost nutritious choices** (see Appendix H).
- **Compare prices.**
  No-name or store brands may be better buys.

  Larger sizes are not always cheaper. They are a bargain only if you can use that amount or have a place to freeze or store the food properly.

  Take time to compare fresh, frozen and canned foods to see which is cheapest. Buy what is on special and what is in season.

  Look for the unit price to compare similar foods.
- **Stick to the outer aisles, and bend and stretch.**
  The outer aisles are where you will find basic foods from the four food groups.
  Bargains are often found on the top and bottom shelves.
- **Eat before you shop.**
  If you are hungry, you may be tempted to buy snack foods (chips, pop, chocolate bars, cookies) and other foods that are not on your list.
- **Check the "Nutrition Facts" labels on foods.**
  With the "Nutrition Facts" information, you can compare similar foods and make healthier food choices.
  Choose foods that have less fat and sodium, and more vitamins, minerals and fibre.
- **Stock up on sale items.**
  Buy as many as you can afford and can use before they are no longer safe or good to eat.
- **Pick up refrigerated and frozen foods last.**
  Make the grocery trip the last on your list of errands. Then go directly home to store the food properly.

Appendix H
Low-Cost Nutritious Choices

Food Group	Low-Cost Nutritious Choices	
Grain Products	bread rice pasta rolled oats barley homemade muffins	♦ Look for bargains on day-old bread and bakery products. ♦ Buy regular rice, oatmeal and ready-to-eat cereals instead of instant and flavoured types. ♦ Try whole-grain bread, brown rice and whole wheat pasta to add nutrients and variety to family meals.
Vegetables & Fruit	cabbage carrots potatoes squash turnip vegetables from the garden frozen or canned vegetables apples local berries in season unsweetened 100% fruit juice (canned or frozen)	♦ Look for large bags of frozen vegetables. They may be bargains and you can cook just the amount you need, close the bag tightly, and put the rest back in the freezer. ♦ Grow your own vegetables if possible. ♦ Buy fresh vegetables and fruit in season, when they generally cost less. ♦ Try frozen or canned vegetables and fruit in the winter when they are often a better buy. ♦ Choose canned vegetables less often than frozen, and rinse well as they can be high in salt. ♦ Frozen concentrated fruit juice may be cheaper than fresh juice, and provides the same nutrients.
Milk Products	milk powder plain milk or yogurt	♦ Non-fat milk powder is the least expensive way to buy milk. Mix it several hours ahead and refrigerate so it can get cold before drinking. ♦ Buy fresh milk in large containers as they generally cost less. ♦ Buy fat-free or low fat milk products more often. ♦ Choose plain yogurt and add fruit at home for flavour and added nutrients.
Meat & Alternatives	baked beans eggs dried beans, peas, lentils canned fish (mackerel, sardines, tuna, salmon) ground beef	♦ Look for specials at the meat counter. Buying meat on sale can mean big savings. ♦ Buy chuck or bottom round roast instead of sirloin. These cuts have less fat and cost less. They need to be covered during cooking and cooked longer (such as in a stew) to make the meat tender. ♦ Buy a whole chicken and cut it into serving size pieces yourself. ♦ "Stretch" meats by serving stews, soups, spaghetti sauce, chili and stir-frys. ♦ Use dried beans, peas and lentils sometimes instead of meat, poultry or fish. They cost less and provide many of the same nutrients. They are also lower in fat. ♦ Eggs are nutritious and quick and easy to prepare. Eggs should be refrigerated and the shells should not have any cracks.
General Tips	♦ Basic, unprocessed foods are less expensive and more nutritious. ♦ Buy bulk foods when they are available. They can be lower in price than similar foods sold in packages. You can buy just the amount you need.	

Tips to Make Convenience Foods More Nutritious

Add nutritious foods, such as:

- any vegetable (fresh, frozen, canned)
- meat, fish, canned tuna
- extra cheese
- leftover pasta, rice
- cooked/canned dried beans, peas or lentils
- milk (e.g. make soup with milk instead of water)

Appendix I
Standard Nutrition Facts Label

The **"Nutrition Facts"** table is easy to find, easy to read and on more foods.

★Information in the Nutrition Facts table is based on a specific amount of food. Compare this to the amount you eat.

★★Use % Daily Value to see if a food has a little or a lot of a nutrient.

Nutrition Facts

Per 125 mL (87 g)*

Amount	% Daily Value**
Calories 80	
Fat 0.5 g	**1** %
Saturated 0 g + Trans 0 g	**0** %
Cholesterol 0 mg	
Sodium 0 mg	**0** %
Carbohydrate 18 g	**6** %
Fibre 2 g	**8** %
Sugars 2 g	
Protein 3 g	

Vitamin A	2 %	Vitamin C	10 %
Calcium	0 %	Iron	2 %

For more information on nutrition labelling regulations and education resources, consult <www.healthcanada.ca/nutritionlabelling>.

Appendix J
Tips for Safe Food Handling

CLEAN:

- Wash hands, utensils and surfaces with hot soapy water before, during and after preparing foods.
- Sanitize countertops, cutting boards and utensils with a mild solution of bleach and water (1 teaspoon bleach per 3 cups water).
- Consider using paper towels to clean up kitchen surfaces. Wash cloth towels, dishcloths or sponges often, and every time they have touched raw meat or poultry juices. Use hot soapy water or the hot water cycle of the washing machine.
- Wash all vegetables and fruit thoroughly before eating or cooking them.

SEPARATE:

- Keep raw meats and poultry away from other foods during storage and preparation.
- Use separate cutting boards for raw meats and for vegetables.
- Always keep foods covered.

COOK:

- Cook (or dry) food thoroughly. Cooking times and temperatures vary for different meats and poultry.
- Prepare foods quickly, and serve right away so foods do not linger at room temperatures where bacteria can grow.
- Do not eat raw meat, fish or poultry, raw eggs, and unpasteurized milk products or fruit juices.

CHILL:

- Refrigerate or freeze foods that can spoil at room temperature, prepared food and leftovers within 2 hours.
- Make sure the fridge is set at a temperature of 4°C (40°F) and keep the freezer at -18°C (0°F).

Other:

- Never buy cans that are dented, rusty or bulging. Their contents may not be safe to eat.
- If in doubt, throw it out. You cannot always tell by its look, smell or taste if a food is spoiled.

Adapted from FightBAC™ campaign materials <www.canfightbac.org>