Lecture 13 – DISEASE RELATED DIETS: NUTRITION & DIET THERAPY

1. For each of the following conditions: celiac disease, inflammatory bowel diseases, short-gut syndrome and re-feeding:
   a. Describe the effects of the condition on dietary intakes & nutrition status.
   b. List & describe the rationale for specific nutrient needs.
   c. Identify the goal(s) of nutrition & diet therapy.
   d. Describe the therapeutic diet & the strategies to support the achievement of the goal(s)
   e. Describe some patient nutrition education & counselling needs.

2. Identify the rationale & indications for vitamin & mineral supplementation in selected diseases/conditions: celiac disease, inflammatory bowel diseases, short-gut syndrome, re-feeding syndrome.

3. Identify the indications for nutrition support in the management of inflammatory bowel diseases & short-gut syndrome (enteral nutrition support (EN) & parenteral nutrition support (PN)).

Celiac Disease:

Nutrition Status	• Protein – energy malnutrition (BMI, growth) • Anemia – iron, folate and/or vitamin B12 deficiencies • Metabolic bone disease – bone density, serum vitamin D • Abnormal bowel function – acquired lactate deficiency, constipation, diarrhea • Nutrition status doesn't appear to correlate well with degree of villous atrophy	
Nutrition goals	• Reverse malnutrition, optimize nutrition status & restore normal growth • Resolve nutrient deficiencies • Complete healing of the GI mucosa, skin lesions	
Diet	Recommended dietary pattern	• Gluten free for life (should only be initiated after a confirmatory diagnosis)
	Supplementation	• Correct micronutrient deficiencies

Patient education	• Work & effort required to change long-established eating & food selection patterns + ongoing vigilance to maintain a gluten-free diet
	• Achieving an adequate and balanced dietary intake is challenging
	  ○ Most gluten-free grains aren't fortified (iron, thiamine, niacin, riboflavin and folate)
	  ○ Tendency to be lower in dietary fibre
	• Significant number experience difficulty purchasing & preparing gluten-free foods, eating with family & friends, in restaurants, school, work or during travel
	• Relief & acceptance of diagnosis, but also frustration & sense of isolation (appears to improve over time)
	• Social, peer & NPOs (ex// Canadian Celiac Association) have considerable influence on successful self-management	

Inflammatory bowel disease:

Nutrition Status	• Malnutrition affects 20 – 85% (weight loss, growth failure, loss of appetite)
	• Malabsorption (esp. Crohn's) – vitamin B12, vitamin A, zinc, magnesium
	• Decreased dietary intake
	  ○ Increased needs (energy, protein, micronutrients – esp. folate, calcium)
	  ○ Increased nutrient losses (iron)
	• Food intolerance, food aversions, self-imposed dietary restrictions

Nutrition goals	• Reverse malnutrition, optimize nutrition status & restore normal growth • Resolve nutrient deficiencies • Induce remission, prevent flare

Diet	Recommended diet during flare	• Adequate energy, protein, vitamins & minerals (some above DRIs) from a variety of foods (including B-carotene) • Reduced dietary fibre (esp. insoluble) • Frequent meals & snacks • Limit sugar & dietary fats (individualize) • Separate solids from fluids (individualize) • Lactose restriction (individualize)
	Supplementation	• Iron, calcium, vit. D, vit. B12, folate, zinc, magnesium • Probiotics (strain specific) – possible role in shortening time to & maintaining remission (esp. in Ulcerative Colitis – UC) • Psyllium – possible benefit for maintenance of remission in UC
Nutrition Support	EN (oral, polymeric)	• To address inadequate macronutrient intakes from food • Crohn's: taken to meet 50% of energy needs; shortens time to remission (esp. children)
	PN	• For achievement of gut rest & restoration of nutrition status in Crohn's with complicated fistulas or post-operative complications
Patient Education	• Disease/illness knowledge to promote self-management o Adequate, balanced dietary intakes +/- supplementation • Optimal health-related quality of life o Avoidance of unnecessary dietary restrictions (2/3 pt restrict food during remission) • Crohn's & Colitis Canada	

Short gut syndrome

Nutrition Status	• Post-operative dependence on PN for adequate macro/micro-nutrient & hydration o Colon resection – greater risk of dehydration due to high volume GI fluid losses o Small bowel restriction – greater risk of inadequate macronutrient absorption & energy intake due to fat malabsorption, mono- & di- saccharide malabsorption • Vitamin B12 and essential fatty acid deficiency • Osteoporosis	
Nutrition goals	• Reverse malnutrition, optimize nutrition status & normalize normal growth • Support adequate hydration • Augment intestinal adaptation	
Diet	Recommended dietary pattern	• Multiple (small) meals per day – goal 50% more than estimated energy needs • Emphasis on complex carbohydrates • Limit sugars • Dietary fats should not be restricted (emphasize essential FAs) o Unless colon is intact – then moderate to control steatorrhea to minimize fluid, electrolyte losses • Emphasis on soluble fibre – up to 1000 kcal derived from SCFA produced by bacterial fermentation; increase transit time
	Supplementation	• Protein supplementation generally not required • Oral rehydration solutions • Oral vitamin & mineral supplementation (above DRIs) o Magnesium & zinc due to high output o Calcium citrate to minimize risk of kidney stone formation o Vitamin ADEK o Intramuscular vit B12 (ileal resections) o Thiamine
Nutrition Support	EN	• Continuous tube feeding may augment rate of intestinal adaptation • Usually polymeric unless malabsorption is severe
	PN	• To restore & maintain adequate nutrition status & hydration, until sufficient bowel adaptation has occurred to enable maintenance of adequate nutrition status

Patient Education	• Strong knowledge of personal gastrointestinal structure & function
	• Strategies to support optimal nutrient status; maintain normal hydration; intestinal adaptation
	• Optimal health-related quality of life
	  ○ Poor sleep – frequent night time urination, bowel movements
	  ○ PN home management
	  ○ Very high "health work" load

Re-feeding Syndrome:

Nutrition Status		• Under-recognized complication of nutrition support among hospitalized patients
		  ○ Under-recognition of malnutrition in the acute care setting
		  ○ Lack of universally accepted definition and means for detecting risk
		  ○ A carefully conducted nutrition assessment will detect under-nutrition, including increased risk of refeeding syndrome due to underlying disease, illness, and therapies
		• Malnutrition in acute-care is costly, delays illness recover, and causes re-feeding complications

Nutrition goals		• Nutritional repletion
		• Prevention of re-feeding complications
		  ○ Malnourished patients do NOT tolerate over-zealous re-feeding!
		  ○ Nutritional rehabilitation and the correction of deficiencies takes time
		  ○ Failure to detect S/S can lead to fatality
		• Gradual, slow incremental increase in the indicated EN/PN according to tolerance (highly individualized)

Diet	Recommended dietary pattern	• Minimal or no nutritional intake for > 5 days: begin nutrition support at ≤ 50% of goal energy intake
		  ○ Patients at high-risk of re-feeding syndrome: 10 kcal/kg/24h
		  ○ Severe malnutrition (BMI ≤ 14): 5 kcal/kg/24h

	Supplementation	• Vitamins – begin before & continue for first 10 days of re-feeding • Minerals – replete low levels before initiating nutrition support • Fluid – restore & maintain adequate fluid volume

4. List some methods for assessing & monitoring nutrition status among patients receiving EN or PN.
   - Nutrition status indicators: macro, micro & hydration status
   - Fluid overload
   - Tolerance/acceptability

5. Explain the risks and benefits of popular diets:
   a. Gluten-free diet (in the absence of celiac disease)

   ???

   b. Low-FODMAPS (**F**ermentable carbohydrates; **o**ligo-, **d**i-, **mono**-saccharides and polyols)
      - Small, short duration, prospective & randomized trials – low FODMAPs may reduce sx of irritable bowel syndrome
      - Meta-analysis – efficacy in management of functional GI sx (of irritable bowel syndrome)
      - No long-term studies on efficacy or safety
        - Reduced bacteria count (bifidobacteria)

LECTURE 14 – DISEASE-RELATED DIETS; NUTRITION & DIET THERAPY PART 2

1. For each of the following conditions: heart failure and renal disease/dysfunction:
    a. Describe the effects of the condition on dietary intakes & nutrition status.
    b. List & describe the rationale for specific nutrient needs.
    c. Identify the goal(s) of nutrition & diet therapy.
    d. Describe the therapeutic diet & the strategies to support the achievement of the goal(s)
    e. Describe some patient nutrition education & counselling needs.

    Answered below under sub-topics.

Heart Failure:

2. Discuss key elements of the nutrition assessment that are focused on for heart failure patients.

Anthropometric	• Weights – UBW, IBW, % losses/gain, weight history, fluid weight vs. lean mass, BMI • Patients weigh themselves daily
Biochemical	• Blood work: lipids, FBG, HbA1c, CRP, pre-albumin, albumin, electrolytes, Mg, PO_4, Ca, iron, Hb • Stool tests – C. diff • Bone density
Clinical	• BP, EF%, NHYA class • Physical activity, smoking, alcohol/drug, family hx • Number of HF hospital admissions, meds, comorbidities
Diet-related hx	• FFQ, 3 day food record, 24 hour recall, previous knowledge • Goals, beliefs, stage of change, motivations, ability

3. What are key nutrients to consider for heart failure management.

Sodium	• Inadequate blood flow to kidneys → aldosterone & ADH secretion → fluid (& Na) retention • Sodium restriction: 2 g/day
Magnesium	• Deficiency common as a result of poor dietary intake & diuretics (increase Mg excretion) ○ Aggravates changes in electrolyte balance - +ve sodium and -ve potassium balance • Should be measured in HF patients
Thiamin	• At risk of thiamin deficiency because of poor food intake, use of loop diuretics & advanced age • Thiamin supplementation can improve LVEF and symptoms
Iron	

4. Understand the current lifestyle management recommendations for persons with heart failure.
    - Sodium restriction to 2g/d
    - Fluid restriction: 1.5 – 2 L/d

5. Understand nutrient interactions and food considerations with HF medications.
6. Describe counselling tips to help with patient education.

Sodium restriction	• Identify sources of sodium and to choose lower sodium options • Read labels for sodium content in foods • Write down food record for analysis • Phone apps; handouts • Decrease processed foods; reduce sodium while eating out; prepare low sodium food at home ○ Low sodium meal delivery – *Better Meals* • If finances are an issue and patient on PWD, apply for funding
Fluid restriction	• Monitor all fluids (anything liquid at room temperature) throughout the day • Teachings around what is a fluid, counting fruits, helping to manage thirst

7. Understand what cardiac cachexia is, diagnosis and current management recommendations.

Definitions	• Multi-factorial disease affecting 5-15% of HF patients
	• Characterized by protein-calorie malnutrition with muscle wasting & peripheral edema
	• Complex imbalance of catabolic & anabolic body systems
	  ○ Caused by a series of immunological, metabolic and neuro-hormonal processes
	  ○ Mediated by sympathetic nervous system activation, pro-inflammatory cytokines, ATII, glucocorticoids and TGF-B

Diagnosis	• 5-6% edema-free weight loss in ≥ 6 months • SGA and MUST assessment tools for malnutrition not sensitive enough or validated for cachexia

Management	• High protein, high calorie, low sodium
	  ○ Energy: 30 – 35 kcak/kg/d or 1.3 – 1.5 REE
	  ○ Protein: 1.3 – 1.5 g/kg/d
	• Optimize nutrient intake to prevent further muscle/weight loss
	  ○ High calorie, high protein diet
	  ○ Size & frequency of meals
	  ○ Supplement diet with multivitamin
	  ○ Assess for deficiencies
	  ○ Decrease in pro-inflammatory lifestyle factors
	  ○ Possible tube feed or TPN to supplement

8. Understand nutrition management for a person with a Ventricular Assist Device (VAD).

- Adequate protein intake
- Anorexia/cachexia
- Early satiety
- Fluid retention or dehydration
- Nutrition post-surgery (wound management)
- Delayed gastric emptying
- Nausea
- Chronic inflammation (CRP levels)
- Stress – GERD, indigestion
- Warfarin & vit K – consistency!!

9. Describe the nutrition considerations for post-heart transplant care.

- Malnourished?
- Medication interactions
- Food safety
- Blood sugar control
- Fluid/salt directly post-transplant
- K, Mg, Ca (bone health), Zn, supplements
- Protein wk 4-6: 1.3 – 1.5 g/kg
  - > 6 wk: 1 – 1.3 g/kg
- Weight management
- Cholesterol management

10. Understand what cardiac allograft vasculopathy (CAV) is, and lifestyle prevention.

Definition	• Accelerated form of CAD • Major factor in limiting long-term survival post-heart transplant • Characterized by concentric fibrous intimal hyperplasia along the length of coronary vessels • Both immunologic and non-immunologic risk factors contribute to development • Difficult to treat → prevention is critical
Lifestyle prevention	• Obesity, dyslipidemia, diabetes, hypertension, metabolic syndrome ○ Hyperlipidemia & insulin resistance most significant non-immunologic factors

Goals of Medical Nutrition Therapy:

- Reduced readmission to hospital
- Reduced length of stay
- Improved compliance/adherence to sodium and fluid
- Address nutrient deficiencies
- Address muscle wasting, cachexia
- Improve quality of life

Renal Disease:

11. What are 4 major manifestations of renal disease (brief overview)?
    - Kidney stones; acute kidney injury; chronic kidney disease; end-stage renal disease

12. Understand what kidney stones are the most common kidney stones (calcium oxalate stones) medical nutrition therapy.

Kidney stones	• Calcium stones are most common: calcium oxalate (60%); calcium phosphate (10%); 10% both • Uric acid (5-10%); struvite (5-10%); cystine (1%)
MNT for calcium oxalate stones	• Drinking adequate fluids • Reducing sodium • Reducing animal protein (meat, eggs, fish) • Getting enough calcium from food or taking calcium supplements with food • Avoid foods high in oxalate (spinach, rhubarb, nuts, wheat bran) • Vitamin D supplements not recommended

13. Understand what acute kidney injury is and medical nutrition therapy. What are the key nutrients to monitor?

AKI	• Sudden reduction in GFR; amount of filtrate per unit in nephrons • Altered ability of kidney to excrete the daily production of metabolic waste
Causes	• Prerenal – inadequate renal perfusion • Intrinsic – diseases within the renal parenchyma • Postrenal – urinary tract obstruction

MNT	• Issue of balancing protein & energy needs with treatment of acidosis and excessive nitrogenous waste is complex
	  ○ Protein amount is influenced by underlying cause & presence of other conditions
	  ▪ Non-dialysis: 0.5 – 0.8 g/kg; dialysis: 1-2 g/kg; CCRT: 1.5 – 2.5 g/kg
	  ▪ When stable: 0.8 – 1 g/kg → 60 – 70% high biological value (HBV)
	• Other nutrients: sodium, potassium
	• Mortality rate increases in malnourished patients

14. What are the stages of chronic kidney disease (CKD)?

1	90-130 mL/min	Kidney damage but normal to increased kidney function
2	60-89 mL/min	Mild decrease in function
3	30-59 mL/min	Moderate decrease in function
4	15-29 mL/min	Severe decrease in function
5	<15 mL/min	Kidney failure with treatment necessary (ESRD)

a. Understand what different nutritional therapy may be proposed at each stage.

Goals of MNT	• Manage sx (edema, hypoalbuminemia, hyperlipidemia) • Decrease risk of progression to renal failure • Maintain nutritional stores • Each stage of CKD has different therapy
Protein reduction	• Reduction to 0.8 g/kg/day may decrease proteinuria without adversely affecting albumin ○ 60% from HBV • Preserves renal function in mild-mod renal failure; should restrict if GFR <30
Sodium	• 2-3 g/day
Potassium	• Monitored especially in stage 4 CKD; may need to be reduced/restricted

Phosphorus	• Serum PO_4 elevates as GFR decreases
	  ○ Early initiation of PO_4 reduction therapies is advantageous for delaying hyperparathyroidism and bone disease
	  ○ GFR <60 should be monitored
	• Phosphate binders may be needed (calcium carbonate or acetate, sevelamer, lanthanum)

Vitamins	• Multivitamin (with water soluble vitamins) – custom supplement for renal pts

15. Understand what cardio-renal syndrome is.

- Cardiorenal syndrome = bidirectional interaction between kidney disease and heart disease
    - Mortality increased in pts with HF who have reduced GFR
    - CKD patients are at risk of atherosclerotic CVD & HF
    - Acute or chronic systemic disorders can cause both cardiac & renal dysfunction
- CRS defined in National Heart, Lung & Blood Institute = therapy to relieve congestive sx of HF is limited by a decline in renal function manifested by reduced GFR

16. What is end stage renal disease (ESRD)?

- ESRD = inability to excrete waste products, maintain fluid & electrolyte balance and produce hormones
    - Circulating nitrogenous waste → uremia (malaise, weakness, N, V, muscle cramps, itching, metallic taste, neurologic impairment)
- 90% of ESRD patients have chronic DM, HTN, and/or glomerulonephritis

a. What are the different options for dialysis (review)?

Hemodialysis	• Fluid & electrolyte content is similar to normal plasma • Waste products & electrolytes move by diffusion, ultrafiltration and osmosis from the blood into the dialysate, and then removed • 3-5 hours 3x per week
Peritoneal dialysis	• Makes use of body's own semipermeable membrane – peritoneum • High dextrose dialysate instilled into peritoneum, diffusion carries waste products from blood through peritoneal membrane and into dialysate, water moves by osmosis • Tissue weight gain can occur due to absorbing 400-800 cal/d from glucose in the dialysate

17. Understand the goals of medical nutrition therapy in the management of ESRD.

- Prevent deficiency and maintain good nutrition status
- Control edema and electrolyte imbalance by controlling sodium, potassium and fluid intake
- Prevent or slow the development of renal osteodystrophy by controlling Ca, PO_4, vit D and PTH
- Enable patient to enjoy their food as much as possible with the restrictions
- Coordinate patient with good care team management
- Provide ongoing counseling and long-term monitoring

a. Understand what nutrients are monitored for nutrition intervention.

Protein	• Dialysis is a drain on body protein → protein intake must be increased
	  ○ PD: 1.2 – 1.5 g/kg/d (at least 50% from HBV)
	  ▪ Protein losses of 20-30 g/24h occur in PD (average 1g/hr)
	  ○ HD 3x/wk: 1.2 g/kg/d
	• Patients on dialysis with low albumin levels have much higher mortality rates
	• Serum BUN, creatinine levels, uremic symptoms and weight should be monitored
	  ○ Albumin more routinely used as nutritional marker rather than pre-albumin (which is metabolized by kidney so is routinely elevated in renal failure)

Fluid/sodium	• Assessed with looking at weight, edema, serum sodium level, dietary intake & BP
Phosphorus	• Large molecular weight = not easily removed by dialysis → restriction & binders required ○ NOTE: food sources are about 60% absorbed; additives can be 100% absorbed • SEs of binders: GI distress, diarrhea, gas, severe constipation/impaction • Phosphate restriction MAY need to be lifted at times to allow more dairy products to meet protein needs
Potassium	• Usually needs restriction

Calcium and PTH	• Balance between phosphate and calcium is difficult for body to maintain 1. Decreased ability of kidney to convert vit D to active form 2. Decreased calcium can cause over-secretion of PTH → resorption of bone 3. Need for serum calcium increases as serum phosphate increases
Iron & EPO	• Anemia caused by inability of kidney to produce EPO (stimulates bone to produce RBCs) ○ Synthetic form of EPO used to treat anemia ○ Iron IV supplementation also used when hematocrit rises (oral iron not effective) • Serum ferritin = accurate indicator of iron status in renal failure
Vitamins	• Water soluble vitamins are rapidly lost during dialysis; also PO_4 and K restriction ○ Require supplementation

LECTURE 19 – DISEASE RELATED DIETS: NUTRITION & DIET THERAPY PART 3

Diabetes:

1. Understand what prediabetes is and what are at least 3 ways lifestyle can play a role to prevent diabetes.

Pre-diabetes	• BG higher than normal; Hb 5.7 – 6.4% • 50% will develop DM2
Lifestyle	• Clinical trials comparing lifestyle interventions to control group reported RRR 29-67% for DM2
MNT goals	• Healthy food choices for moderate weight loss (5%) ○ Obesity has an impact on insulin sensitivity • Encouraging fiber intake improves insulin sensitivity • Meal patterns & portion sizes

2. Understand what role carbohydrates play in diabetes (DM) management.
   - Blood glucose levels after eating are primarily determined by rate of appearance of glucose from carb digestion & absorption into blood steam + ability of insulin to clear glucose from circulation
   - Balancing amount of carbs, overall nutrition & BG levels
     - Day-to-day consistency important, especially if on MNT alone, glucose lowering meds, or fixed insulin regimens
   - In persons with DM1 or DM2 who adjust meal-time insulin, or are on insulin pump therapy, insulin can be adjusted to match carb intake (insulin:carbohydrate ratios)

3. Understand 2 key strategies to monitoring carbohydrates and overall meal balance for DM management.
   a. Plate method and carb counting

Carb counting	Plate method
• Food portions contributing 15 g of carbs = 1 carb serving	• ½ vegetables (at least 2 kinds) • ¼ starch and ¼ protein

   b. Understand when and why each may be used
   - Need to determine what the patient is able to handle
   - What variation in their diet and eating patterns do they have?
   - What might give the person the most success with their blood sugar levels?

4. Understand how the Glycemic index is used and what it is.
   - Developed to compare the physiologic effects of carbs on glucose
   - Low GI foods often increase satiety, which may also decrease the amount one consumes
     - Limitation: variability of response to a specific carb food
     - Note: if a carb food is combined with fats & protein, it changes how fast that food is absorbed
   - Glycemic load is also important

5. Understand carbohydrate counting and how to apply it to a meal plan.
   - Insulin:carbohydrate ratios discussed with RD, RN and endocrinologist → allows for self adjustment
   - Patients often keep a cheat sheet of how much carbs different food servings have
   - Number of carb servings/meal depends on goals for a patient, and whether a patient is sedentary or active
     - Typical amounts: 2-5 servings
     - Most women/less active men = 3-4 servings (45-60 g)
     - Most men/more active women = 4-5 servings (60-75 g)
     - If weight loss is a goal, this may be adjusted safely with patient by RD
   - Servings include dairy/alt, fruits/veggies, starches

6. Understand how fibre is accounted for on a label with carbohydrate counting.
   - Fibre doesn't raise blood glucose levels (therefore subtract from carbohydrate counting)
     - Ex// whole wheat bread = 36 g carbs / 2 slices; fiber = 6g → 30 g carb / 2 slices = 15 g carb / slice

7. Understand how sugar alcohols are accounted for in carbohydrates/calories.
   - Only partly absorbed, have fewer calories than sugar and have no major effect on blood glucose
   - >10 g/day → SEs (gas, bloating, diarrhea)

8. Be familiar with different types of sugar substitutes and their role for diabetic patients.
   - Acesulfame potassium, aspartame, cyclamate, saccharin, sucralose, steviol glycosides
   - Evidence for sugar substitutes in weight loss is mixed, possible reasons cited are:
     - Sugar substitutes are sweet and increase preference for sweet foods
     - Hormones not released to tell body it is full and could lead to increased calories later
     - Psychological – those that knew they were eating sugar substitutes tended to compensate by increasing calories other ways, while those that didn't know tended to decrease calories overall
     - More studies needed to look at long-term weight loss

9. Understand what are the protein and dietary fat recommendations for DM management

Protein	• Minimal acute effects on glycemic response & no long-term effect on insulin requirements • Usual recommendation: 15 – 20% of total calories ○ Including protein with each meal can help patients with satiety and portion sizes • Short-term, small subject numbers: protein > 20% of total energy may improve glucose & insulin concentrations, reduce appetite and improve satiety → assist with weight loss for some pts
Dietary Fat	• 2-3 servings of fish per week recommended (omega 3 content) • If diet = 20% protein, 45-50% carbs, then fat is 25-30% ○ Canadian Cardiovascular Society: 9% saturated (7% if dyslipidemia), therefore 21-23% unsaturated (MUFA and PUFA) • Encouraging more unsaturated fats (unsalted nuts & seeds, avocado, fish, extra virgin olive oil) can be beneficial for satiety at meals, nutrient absorption and CV health
Ketogenic Diet	• Diet 10% carbs, 70% fat, 20% protein • Current studies are short-term, small number of subjects

10. Understand what needs to be considered for DM patients and exercise.

Hypoglycemia	• Concern for DM1, and to a lesser extent in DM2 using insulin or insulin secretagogues
	• If pre-exercise BG levels <5.5 mmol/L → ingest 15 – 30 g carb before exercise
	  ○ Amount depends on injected insulin, exercise duration & intensity, results of BG monitoring
	• If diabetes is controlled by lifestyle or oral hypoglycemic agents that don't increase insulin levels, risk of developing hypoglycemia during exercise is minimal
	  ○ Most will not need to monitor BG levels or require supplements with carbs for exercise <1h

Hyperglycemia	• In DM1 who are severely insulin deficient (ex// insulin omission, illness) hyperglycemia can be worsened by exercise • Blood or urine ketone bodies can be tested to assess best course of action • Important to ensure proper hydration & monitor for S/S, especially for exercise in the heat

11. Understand why a whole family approach to counselling is beneficial for children with obesity and/or type 2 diabetes.
    - Fostering a healthy relationship with food for the child and the family is important
    - Family-based lifestyle interventions with a behavioral component aimed at changes in diet and physical activity patterns have shown to result in significant weight reduction in both children and adolescents

12. Name 5 factors that could increase a child's risk for developing type 2 DM.
    - Being overweight or inactive
    - Ethnicities at high risk for DM2 (African, Hispanic, Asian, South Asian, Aboriginal)
    - Family history of DM2
    - Mother with gestational diabetes
    - High fat or cholesterol in blood
    - High levels of fatty deposits in liver
    - High blood pressure
    - Polycystic ovarian syndrome
    - Certain meds for mental health conditions

13. What are important considerations for children and youth diagnosed with type 1 diabetes.
    - Nutrition management of pediatric diabetes needs to consider both optimal growth & development + tight BG control
    - Important to note that infants & toddlers often have erratic eating schedules
        - Amount of carbs they eat at a meal may differ (esp. picky eaters)
        - Helping parents & children to understand carb counting is important (in foods AND meal plan)
    - Insulin pumps has allowed more flexibility in the diet (pumps covered for pediatric patients)
    - Higher risk of eating disorders in youth DM1
        - Often associated with insulin omission to lose weight & impaired metabolic control
        - With increased independence in adolescence (incl. food choices & influences), positive relationship with food is very important
    - Celiac disease in 4-9% of children with DM1 (although 60-70% of these children are asymptomatic)

14. List 3 types of supplement beverages that are available for diabetic patients and 2 key characteristics of their components.
    - Glucerna bars and beverages
    - Diabetic resources - tetras and tube feed
    - Boost Glucose Control

    ➔ Lower amount of carbohydrates and added sugars, and higher in fibre

LECTURE 20 – DISEASE RELATED DIETS: NUTRITION & DIET THERAPY

1. Understand what the current CCS (Canadian Cardiovascular Society) nutrition guidelines are for 2016.

Fat (unsaturated & saturated)	• Limit total fat to < 30% of daily energy • Emphasize PUFA (in particular omega-3 from fish) and MUFA • Saturated fats (SFA) < 7% (dyslipidemia) or < 9% (no dyslipidemia) of daily energy
Dietary patterns	• Recommended diets: Mediterranean, Portfolio or DASH diets
Cholesterol	• Dyslipidemia or high risk of CVD: limit cholesterol to 200 mg daily • Others: no specific restricted
Key foods to lower cholesterol	• Increase phytoesterols, soluble fiber, soy, nut intake
Other	• Increase fiber to > 30 g • Limit alcohol to ≤ 30 g (1-2 drinks) • Smoking cessation • Engage in regular activity

2. The World Health Organization's recommendations for added sugar.
   - < 5-10% added sugar per day

3. What are 3 ways diet can affect heart health and what can they modify?

Diet can modify..	**By affecting ...**
Lipid concentration	• Cholesterol absorption • Chylomicron and VLDL production • Regulation of LDL receptors
Progression of CVD	• Oxidation of LDL cholesterol • Thrombogenesis • LDL particle size
Plays a role in inflammation and oxidative stress	

4. Understand the importance of what is replacing saturated fats or other nutrients in decreasing risk.

SFA controversy	• Believed that if SFA increased total cholesterol, they must increase heart disease risk
Evidence of dietary changes	• Replacing SFA with carbs (particularly refined carbs) <u>exacerbated</u> atherogenic dyslipidemia • Replacement of SFA with PUFA reduces CHD Risk
Questions to consider	• What are we replacing the SFA or carbs with? • How does changing macronutrient percentages in our diet affect health? • What about dairy SFA vs. meat/poultry SFA? • What are other factors from diet affecting heart disease? Serum cholesterol profiles are an important risk factor but there are others. • Is it possible that fats express differently in the context of other components of a diet?
Current recommendations	• Fat 20-35% CHO 45-65% Protein 10-35% • Linoleic acid (omega-6) 5-10% alpha Linolenic acid (ALA) (omega 3) 0.6 – 1.2%

5. Understand why a balance of omega 3s and omega 6s are important in the PUFA intake profile and why it is important in heart health.
   - When unsaturated fats are substituted for SFA, it reduces LDL cholesterol by up-regulating LDL receptors
   - Increased PUFA intake relative to saturated fats results in a decrease in Apo B production → reduce CHD risk
     - HOWEVER, need to consider the balance between omega-3 and omega-6 because studies found increased risk of death with replacing SFA with mostly omega-6

6. Understand the role of omega 3 supplements.
   - Benefit for very high triglyceride levels
     - 2-4 g of fish oil lowered high TG levels by 25-30%

7. List 4 types of saturated fats and what type affects lipids more favourably.

Lauric acid (C-12)	Coconut oil, palm oil	Increases LDL cholesterol by down-regulating LDL receptors
Myrstic (C-14)	Coconut oil, dairy, palm oil	
Palmitic (C-16)	Palm oil, meat, cheese	
Stearic (C-18)	Coco butter, meat	Foods higher in stearic acid appear to affect lipids more favourably

8. Be able to calculate how much fat in grams is 7% (dyslipidemia) or 9% (no dyslipidemia) or 30% (total fat) of a pt's diet.
   - 1 tsp = 4 g of fat = 36 kcal
   - Ex// total daily intake 1500 kcal = 166 g fat → total fat (30%) = 50 g; SFA (7%) = 11 g; UFA (total – SFA) = 39 g
     - For most people SFA < 20 g/d

9. Be able to give examples of two types of foods that are high in monounsaturated fats and polyunsaturated fats.
   - MUFA**:** olive oil, canola, avocado, nuts
   - PUFA: essential fatty acids (omega 3 and 6); safflower, sunflower, corn, soybean oils; nuts, seeds; fatty fish

10. Understand the pros and cons of coconut oil for heart health.

Pros	Cons
• Solid at room temperature • Good shelf-life • Moderate heat point	• Found to raise total LDL to a greater extent than unsaturated oils BUT lesser extent than butter • Need to consider dietary pattern and if this is the primary fat source or main SFA source
RECOMMENDATION: use a variety of oils; consider total SFA in day + balance of PUFAs and MUFAs	

11. Understand what smoke point is and its importance in choosing a vegetable oil to use.
   - **Smoke point** = temperature at which an oil starts to burn and smoke (often more refined = higher smoke point)
     - Phytochemicals can be destroyed and can cause free radicals
   - High to low smoke point: avocado > grapeseed > canola (refined) > butter > EVO > flaxseed

12. Be able to give 3 practical tips in regards to fat intake.
   - Trim fat off meats, remove skin off chicken; marinating longer can increase meat tenderness and flavour
   - Limit butter intake and replace with unsaturated fats (avocado, unsalted nut butters, non-hydrogenated margarines, olive oil and other vegetable oils)
   - Use unsalted nuts as snacks (up to ¼ cup per day)
   - Consume fish 2-3 times per week and eat vegetarian at least 1 time per week

13. Understand the role carbohydrates plays in heart health and CCS recommendations.
   - Low GI dietary patterns recommended
   - If saturated fats are replaced with MUFAs and carbs, then people should choose plant sources of MUFAs (olive oil, canola oil, nuts and seeds) and high-quality sources of carbs (whole grains and low GI carbs)

14. What are the 3 key dietary patterns recommended by the CCS?

Mediterranean Diet	• Shown to improve lipid profiles and reduce CVD mortality • Servings/day: veggies 2-4 cups; fruits 1-2 cups; dairy 1-3; whole grains/starch veg 4-6; nuts/legumes 1-3
Portfolio Diet	• 4 dietary components: nuts 30 g; soluble fiber > 10 g; soy 25 g; phytosterols 2 g ○ Each have been shown independently to lower cholesterol
DASH diet	LO # 19

15. Understand the role of soluble fiber in heart health and the therapeutic amount recommended for dyslipidemia.
   - Fiber (especially soluble) reduces LDL cholesterol by reducing cholesterol absorption, increase bile excretion of cholesterol and up-regulate LDL receptors
   - Choose whole-grain, high-fiber foods
     - Aim 20-40 g fiber/day (range due to age, weight)
     - Aim 10-25 g of viscous (soluble) fiber /day
   - Total fiber = soluble + insoluble fibers
     - Soluble: oats, beans, lentils, barley, psyllium, some fruits & veggies, pectin
     - Insoluble: wheat bran, whole grain foods, skins/seeds, nuts & nut butters, fruits & veggies

16. What are phytosterols and how do they therapeutically benefit heart health?
    - Work by blocking cholesterol absorption in the intestines
        - 2g of phytosterols/day can lower cholesterol by up to 9%
    - Found in plant foods that contain high fat or fiber content (wheat germ, nuts, seeds, legumes, soybeans, vegetable oils and fruits/vegetables)

17. Understand what the therapeutic lifestyle changes (TLC) are and what their cumulative benefit can be.

	Dietary component	**Dietary change**	**Approx.. LDL-C reduction**
Major interventions	Saturated fat	< 7% of calories	8-10%
	Dietary cholesterol	< 200 mg	3-5%
	Weight reduction	Lose 10 pounds	5-8%
Other options	Viscous fiber	5-10 g/d	3-5%
	Phytosterols	2 g/d	6-15%
Cumulative estimate			**20-30%**

18. What are 3 practical tips to implement a healthy heart dietary pattern?
    - How do we keep track as to whether we are following a healthy dietary pattern?
    - Start tracking how many time you dine out?
    - Take a look at your grocery cart/bill, how much of it is fresh produce (fruits, veg, fresh meats, fish, etc)?
    - How many fruits and vegetables do you eat in a day?
    - What canned/packaged foods are you using? Are you adding fresh to frozen, canned or packaged?
    - Start observing what you are doing daily and weekly
    - Dietary pattern is built over time

19. Understand what the DASH diet is and what are key points of how it can help to reduce hypertension.
    - DASH diet in adults with HTN was associated with reduced risk of stroke & reduced all-cause mortality
    - Servings/d: whole grains 6-8; fruits 4-5; vegs 4-5; low-fat milk/alt 2-3; fish & lean meat <6 oz; nuts, fats & oils 2-3 tsp
    - Servings/wk: nuts, seeds, legumes 4-5; sweets ≤ 5 tbsp (1 tbsp = 15 g)

20. Be able to make 3 suggestions to make a diet more heart healthy.
    - Decreasing saturated fats from meats and butter (in particular) has been shown to be beneficial for reducing LDL-C
    - Increasing fruits & veggies to at least 7 servings/day can achieve at least 7g of soluble fiber beneficial to heart health
    - Reducing processed foods and dining out can assist in decreasing sodium intake & increasing fiber + other nutrients
    - Be carb conscious – reduce added sugars to < 5-10% and choose low GI, high-fiber starches

21. Have an understanding of the burden comorbidities can be on a patient in regards to their diet.
    - Warfarin – consistency with vitamin K intake
    - Many medications – avoid grapefruit
    - Diuretics - ↑↓ potassium
    - Salt – restrict or decrease
    - Diabetes
    - Reducing saturated fats

LECTURE 16 – MULTIPLE VITAMINS AND MINERALS

1. To discuss appropriateness of daily multivitamins in otherwise healthy individuals.
    - Why are you interested in taking a supplement? Is there a condition they want to treat/prevent?
    - Evidence vs. safety issues?
    - Current diet; current medications; allergies?
    - If starting a supplement: dosing, duration, potential SEs, etc

2. To discuss the evidence with respect to use of ocular vitamins and multivitamins.

Vitamins for age-related macular degeneration	• Antioxidants + Zn 80 mg, copper 2 mg, for intermediate or advanced AMD ONLY:
	  ○ Fewer pts progressed to a more advanced AMD or wet AMD
	  ○ Pts on treatment had reduced rate of 15 letter visual acuity loss (vs. placebo)
	• Modifications to above regimen:
	  ○ Omega-3s, xanthophylls: no additional benefit
	  ○ Xantophylls: safer than beta-carotene
	  ○ Removing beta-carotene: didn't decrease benefit
	  ▪ B-carotene increases yellowing of skin, and lung cancer in smokers

Antioxidants	• Vit A, vit C, vit E, selenium vs. placebo ○ Increased mortality – specifically w/ b-carotene, vit E, high-dose vit A (>5000 IU)
Multivitamins in healthy populations	• No effect on overall mortality, CVD/cancer mortality, CVD events, cancer incidence
Multivitamins for children	• Generally not needed if eating well (according to dietary guidelines) and are growing
Multivitamins for teens	• Time of increased bone formation • Increased iron requirements • Time of changes in diet (vegetarian, calorie cutting, increased junk food, etc) • In Canada, the nutrients with lowest intakes are vit A, D, Mg, PO_4, Ca

3. To compare and contrast available products.
   - Ocular vitamins: Ocuvite, Vitalux, I-Care
   - Multivitamins: Centrum (Regular, Forte, Silver [Canadian closest to Select Essentials 50+]), Super VitaVim
   - Children's: Centrum Junior, Flintstones Multiple Vitamins
   - ➔ Comparisons to DRIs in slides

LECTURE 17 – CALCIUM AND VITAMIN D (BONE HEALTH)

1. Describe the clinical risk factors for fracture.

Age < 50 year	Age 50 – 64 years	Modifiable factors
• Fragility fractures • Use of high-risk medications • Hypogonadism • Malabsorption syndromes • Chronic inflammatory conditions • Primary hyperparathyroidism • Other disorders associated w/ rapid bone loss/fractures	• Fragility fracture after age 40 • Parental hip fracture • Vertebral fracture or osteopenia (radiography) • Prolonged use of glucocorticoids /other high-risk meds • High alcohol intake or current smoking • Low body weight (<60 kg) or major weight loss (>10% of body weight at age 25) • Other disorders strongly associated with osteoporosis	• Low calcium (and vit D) intake • Propensity to fall • Increased dietary pattern? • Sedentary lifestyle • Increased caffeine/alcohol intake • Current tobacco use • Increased carbonated beverage use?
NOTE: all men and women > 65 years should be investigated (per CPG)		

2. Estimate a person's 10-year risk of fracture.
   - FRAX tool

3. Determine an individual patient's daily elemental calcium and vit D requirements (based on the Health Canada/IOM standards), his/her average intake through foods and supplements, and appropriate recommendations to make up any deficit between current intake and requirements.

Age group	Calcium Intakes		Vit D Intakes	
	RDA (mg)	UTL (mg)	RDA (IU)	UTL (IU)
0 – 6 months	200	1000	400	1000
7 – 12 months	260	1500	400	1500
1 – 3 years	700	2500	600	2500
4 – 8 years	1000	2500		300
9 – 18 years	1300	3000		4000
19 – 50 years	1000	2500		
51 – 70 years	Males: 1000 Females: 1200	2000		
> 70 years	1200	2000	800	4000
Pregnancy/Lactation **14-18 years** **19-50 years**	 1300 1000	 3000 2500	600	4000

a. Know the elemental calcium and vit D content of the listed foods, supplements, and different calcium salts.

Food and serving size	Calcium (mg)	Vitamin D (IU)
Milk, 1 cup	300	90
Hard cheese, 50 g	370	
Egg yolk, 1		25
Cottage cheese, 1 cup	150	
Yogurt, fruit bottom, ¾ cup	230	
Orange, 1 medium	50	
Tofu (calcium sulphate), 150 g	350	
White beans, ¾ cup	120	
Almonds, ¼ cup	90	
Atlantic sardines (with bones), 75 g	280	70
Pacific sardines canned, 75 g		585
Salmon canned (with bones), 75 g	200	585
Tuna canned, 75 g		44
Rice or soy beverage (fortified), 1 cup	300	90
Regular soy beverage, 1 cup	100	
Fortified orange juice, ½ cup	185	50
Broccoli, ½ cup	30	

Product	Calcium Salt	Calcium (mg)	Vitamin D (IU)
Caltrate	Carbonate	600	
Caltrate 600 + D		600	800
Caltrate Select		600	400
Caltrate Plus		600	800
Caltrate Mini-Cals		300	800
Tums regular		200	
Tums Extra		300	
Tums Ultra		400	
Citracal + D	Citrate	315	200
Citracal petites + D		200	200
Novo-calcium gluconate 650 mg	Gluconate	60	
Gramacal	Gluconolactate, carbonate	1000	
Baby D-drops			400
Booster D-drops			600
D-drops			1000

b. Briefly discuss the evidence that opposes these recommendations.

- Inconsistent results with respect to:
  - Dosing; combo of calcium and vit D, or vit D alone
  - Absolute benefit for fractures, fall reductions, other conditions vs. potential harms
- Evidence discussed in LO #6

4. Compare and contrast calcium citrate and carbonate with respect to clinical use, side effects, etc.

Calcium carbonate (40% elemental calcium)	Calcium citrate (21% of elemental calcium)

• Inexpensive
• Contains highest amount of elemental calcium
• Well-absorbed by most of population
• To enhance absorption:
  ○ Take with food (comparable absorption to calcium citrate)
  ○ Take in divided doses
• SEs: flatulence, bloating, constipation
	• More expensive than carbonate in general
	• pH independent
	• Less carbon dioxide production
	• Recommended for patients with: achlorhydria, kidney stones, intolerable gas with carbonate
	• Avoid in chronic renal failure
	  ○ Binds aluminum in dialysis solution

5. Discuss the evidence for the use of calcium and/or vitamin D in fracture reduction, falls prevention, mortality reduction.

Fracture reduction	• Calcium or calcium + vit D: 10% RRR • Dietary calcium: most cohort studies show neutral relationship; RCTs to small to show SS	
Glucocorticoid-induced osteoporosis	• Calcium + vit D more effective at retarding lumbar & forearm bone loss than placebo OR calcium alone	
Falls (in community)	• Vit D supplements MAY reduce falls in older community pts (but only those who have low blood levels pre-treatment)	
Falls (nursing homes or hospital)	• Vit D (800 IU) + Ca (1000 mg): reduced rate of falls, but not risk of falling ○ Pts in study had low or very low vit D levels	
Does calcium need to be taken with vit D? Review of meta-analyses	Fall prevention (9 analyses)	• 2 concluded vit D only effective with calcium • 2 concluded vit D effective alone • Others concluded vit D only effective under certain circumstances ○ Dose ≥ 700 IU/day or people with low serum levels
	Fracture reduction (10 analyses)	• 5 concluded vit D only effective with calcium • 3 concluded vit D alone effective at ≥ 482 IU/day • 2 concluded vit D had no beneficial effect on fracture risk
	All-cause mortality (5 analyses)	• 3 concluded only beneficial if calcium & vit D are combined • 2 concluded vit D alone is beneficial

6. Discuss the evidence for the potential cardiovascular harm of calcium and/or vitamin D.
   - Calcium (w/ or w/o vit D): no relationship to risk of CVD or mortality
   - High calcium: decreased risk of incident atherosclerosis but may increase risk for incident coronary artery calcification

7. Discuss the role of calcium in the formation of kidney stones & counsel on ways to reduce risk of developing kidney stones.
   - Most kidney stones are made of calcium oxalate (precipitation of crystals in urine)
     - LOW calcium diets increase oxalate in urine (and this is likely cause of kidney stones)
     - Dietary calcium binds oxalates in GIT – limits their absorption and prevents precipitation in kidney
   - Patients with calcium oxalate stones can:
     - Limit sources of oxalate (beet greens, rhubarb, sorrel, nuts, berries, spinach, chocolate)
     - Continue with calcium intake – calcium citrate may have a protective effect

8. Correctly advise individual patients on the use of "bone health" nutrition and supplements for general health, treatment or prevention of osteoporosis/bone fracture including treatment regimens and appropriate counselling.

Interactions with Ca	• Phytates (bran, Metamucil, soybeans, seeds, etc) • Some antibiotics (quinolones, tetracyclines) • Thiazides, Bisphosphonates, L-thyroxine, iron, etc
Counselling tips	• Carbonate: with food for better absorption • Citrate: may be taken without regard to food • Divided doses separate from other calcium sources (max single dose 500 mg)
Magnesium	• Concurrent ingestion with calcium (no effects on absorption) ○ Possible benefits: laxative effect (>350 mg) • Has a role in bone and teeth formation • DRI: 320 – 420 mg; sources: whole grains, green leafy veggies, nuts, seafood
Other nutrients	• No evidence to recommend additional intakes for prevention/treatment of osteoporosis

LECTURE 15, 16 AND 22– MICRONUTRIENT PHARMACOLOGY (PARTS 1 AND 2)

1. Define the terms vitamin, mineral, DRI, RDA, AI and UL.

Micronutrients (vitamins & minerals)	• Substances essential in very small quantities for normal metabolic & physiological fxn • Either not formed at all or are formed in insufficient amounts in body ○ Must be supplied from exogenous sources

Dietary reference intakes (DRI)	• Harmonized US & Canadian guidelines for recommended nutrient intakes in healthy pops
	• Evidence-based
	  ○ Consider maintenance of good health & prevention of chronic disease
	  ○ Also considers possible toxicity of excess intake

Recommended dietary allowances (RDA)	• Dietary intake level sufficient to meet needs of 97 – 98% individuals in a group • Calculated based on the **E**stimated **A**verage **R**equirement (EAR) = the median daily intake estimated to meet the requirement of 50% of healthy individuals in a group
Adequate intake (AI)	• For nutrients for which there isn't enough information to calculate an RDA • Based on the estimated average nutrient intake by a group (or groups) of healthy individual
Tolerable Upper Intake Levels (UL)	• Highest level of daily intake likely to pose no risks or adverse effects to almost all individuals in the general population

2. Differentiate between use of vitamins and minerals as dietary supplements and as therapeutic agents.

Are supplements required?	• Vitamin & mineral needs can (and should usually be met) by eating a balanced diet with a wide variety of foods (ex// Canada's Food Guide)
	• Health Canada also requires the fortification of certain foods in an effort to prevent nutritional deficiencies
	  ○ Vit A & D – added to milk and margarine
	  ○ Thiamine, riboflavin, niacin, folic acid, iron –added to enriched white floor
	  ○ Iodine – added to table salt

When are supplements recommended?	1) Requirements are increased such that it's difficult to obtain sufficient amounts from diet
	  a. Pregnant & lactating women (vitamins, folic acid, calcium + vit D, iron)
	2) Intake from diet is likely to be inadequate
	  a. People on very low calorie diets
	  b. Those who avoid entire food groups (vegetarians, vegans)
	  c. Chronic substance abuse
	  d. Elderly
	3) Malabsorption is a risk
	  a. Following bariatric surgery
	  b. GI diseases known to cause malabsorption (ex// Cystic Fibrosis)

When are vitamins & minerals needed as therapeutic agents?	1) For correction of deficiency (UL do not apply) 2) Use of high doses (generally > 10 times RDA) of one or a few agents in the prevention or treatment of diseases or conditions unrelated to nutritional deficiency

3. For each of the vitamins discussed, state the chemical name of the active substances, and list at least 2 major sources from which the vitamin can be obtained.

Vitamin A	Name	• Collective name for a group of compounds having the biological activity of retinol ○ Retinol, retinal, retinoic acid
	Sources	• Pre-formed, mostly as retinyl esters: from animal sources (liver, eggs, milk) • Pro-vitamin A carotenoids (precursors): from pigmented fruits & veggies ○ B-carotene as largest biological activity; supplements better absorbed than from diet (green, leafy veggies and intensely colored fruits/veggies)
	Requirement	• Vary between 300 – 1300 RAE/day (depending on age, gender, etc) ○ RAE = retinol activity equivalents (1 RAE = 1 ug all-trans retinol)

B-vitamins	Names	• Thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, biotin, folic acid, cyanocobalamin (B12), choline, inositol, carnitine

	Sources	• Thiamine (B1): whole grain cereals, legumes (beans/lentils), nuts, lean pork and yeast
		  ○ In Canada, wheat flour is fortified with thiamine
		• Riboflavin (B2): cereal, nuts, milk, eggs, green leafy vegetables, lean meat
		• Niacin (B3): meat, poultry, fish (tuna, salmon), fortified cereals, legumes, and nuts
		  ○ Also formed from tryptophan, in a reaction that requires B6
		  ○ Less bioavailable from cereal grains
		• Pyridoxine (B6): beans, legumes, nuts, eggs, meats, fish breads, cereals

Vitamin C	Name	• Ascorbic acid
	Sources	• Citrus fruits, green peppers, strawberries, tomatoes, broccoli, sweet & white potatoes
	Requirements	• RDA = 90 mg/d for adult men and 75 mg/day for adult women • RDA increased to 125 (men) and 110 (women) mg/day in smokers
Vitamin D	Names	• Ergocalciferiol (vitamin D2): from yeasts and fungi • Cholecalciferol (vitamin D3): from animal tissues
	Sources	• Formed in skin on exposure to sunlight • Dietary: fatty fish (mackerel, salmon, sardines), fish liver oils, fortified milk • OTC supplements: either vitamin D2 or D3 (50-77% more biological activity than D2)
	Requirements	• IOM: birth – 1 year = 400 IU; 1-70 yo = 600 IU ; > 70 yo = 800 IU • CCS: adults = 1000 IU in winter months, or if at high risk of deficiency • Osteoporosis: low-risk adults <50 yo = 400-1000 IU ; >50+ high risk adults 800-2000 IU
Vitamin E	Name	• Includes 8 naturally occurring compounds called tocopherols ○ Alpha-tochopherol: found in greatest amounts in circulation and tissues
	Sources	• Dietary: vegetable oils, nuts, whole grains (contain the active RRR-α-tocopherol) • Synthetic: contains all rac-α-tocopherol but only 4/9 stereoisomers are biologically active • Supplements: sold as esters of either natural or synthetic vitamin E

	Requirements	• RDA: 4-19 mg of RRR- α-tocopherol/day
		  ○ 1 IU natural vitamin E = 0.67 mg RRR- α-tocopherol
		  ○ 1 IU synthetic vitamin E = 0.45 mg RRR- α-tocopherol

Vitamin K	Name	• Vitamin K_1 = phytomenadione • Vitamin K_2 = menaquinone series
	Sources	• Vitamin K_1: plants, especially vegetables; also synthetic • Vitamin K_2: synthesized by intestinal bacteria

4. Outline the absorption, distribution, and metabolism of vitamins A, C, and D.

Vitamin A	Absorption	• Vitamin A → intestinal mucosa → trans-retinol • Carotenoids → trans-retinol
	Distribution	• Trans-retinol = transport form – bound to retinol binding protein → Retinoic acid – active form in all tissues (except eye) → Retinal – active form in eye
	Metabolism	• Liver via vitamin A esters
Vitamin C	Absorption	• Dose-dependent active transport in upper GIT
	Metabolism	• Approx. 15% converted to oxalic acid
	Excretion	• At low intake, undergoes active tubular reabsorption • At doses ≥ 1000 mg, excess is excreted in urine
Vitamin D	Activation	1) 7-dehydrocholesterol (skin) → SUN EXPOSURE → vitamin D3 (cholecalciferol) 2) Vitamin D3 (skin) → LIVER → 25-OHD_3 (calcifediol) 3) 25-OHD_3 → KIDNEY → 1, 25-$(OH)_2D_3$ (calcitriol)

5. State the physiological function of each vitamin, and where discussed, explain their mechanism of action and regulation.

<table>
<tr><td>Vitamin A</td><td colspan="2">

Retinoic acid (RA) acts by regulating gene expression in target cells:

Circulating retinol is converted to retinoic acid
Acts through nuclear retinoic acid receptors (RAR)

Maintenance of normal vision, particularly night vision

Visual cycle: series of enzymatic reactions for recycling retinoids used in photoreceptor cells of the retina for light detection

Retinol circulates to the retina & moves into retinal pigment epithelial cells → isomerized and oxidized to form 11-cis-retinal
11-cist-retinal transported to rod cells → binds to opsin to form rhodopsin (visual pigment)
Absorption of a photon of light catalyzes isomerization of 11-cist-retinal to all-trans-retinal, changing conformation of rhodopsin & triggering cascade of signalling events → optic nerve transmission → vision
<ol type="a">
AT SAME TIME, all-trans-retinal is released from rhodopsin, converted to all-trans-retinol and transported back to retinal epithelial cell for storage as all-trans retinyl esters → re-entry into cycle

Differentiation and function of epithelial cells
Embryonic development, growth and cell differentiation
Function of the immune system

</td></tr>
<tr><td rowspan="4">Vitamin B</td><td>Thiamine (B1)</td><td>

Essential coenzyme in several decarboxylation reactions in carb & amino acid metabolism
Required for energy generation

</td></tr>
<tr><td>Riboflavin (B2)</td><td>

Converted to FMN (flavin mononucleotide) and FAD (flavin adenine dinucleotide)

Co-enzymes for flavoproteins, act as electron carriers in redox reactions in fatty acid and amino acid metabolism and the TCA cycle
FAD is part of the electron transport (respiratory) chain – central to energy production

Involved in metabolism of vit B6, folic acid, and niacin

</td></tr>
<tr><td>Niacin (B3)</td><td>

Form part of nicotinamide adenine dinucleotide (NAD) and nicotinamde adenine dinucleotide phosphate (NADP)

Co-enzymes in many oxidation-reduction reactions, also participate in DNA repair

</td></tr>
<tr><td>Pyridoxine (B6)</td><td>

As pyridoxal-phosphate in amino acid and glycogen metabolism, and steroid hormone action
Acts as co-factor in conversion of tryptophan to niacin

</td></tr>
<tr><td>Vitamin C</td><td colspan="2">

As an antioxidant in a number of biochemical reactions (ex// conversion of proline to hydroxyproline in collagen synthesis)
Also suggested to protect against free radical-induced damage

</td></tr>
<tr><td>Vitamin D</td><td colspan="2">

Vitamin D acts by regulating gene expression in target cells via nuclear vitamin D receptors (VDR)

Receptors are widespread (brain, prostate, colon, immune cells, etc)

With calcitonin & PTH, regulates serum Ca and Pi levels within narrow physiological range

Supports normal bone mineralization, neuromuscular function and cell physiology

Increases expression of Ca channels, Ca binding proteins, Pi transporter in intestinal epithelial cells → increases Ca and Pi absorption
Enhances mobilization of Ca and Pi from bone (if dietary Ca is insufficient)
Decreases Ca and Pi excretion by the kidney (minor effect)

Controls the expression of more than 200 genes, including for cell proliferation, differentiation, apoptosis

Decreases proliferation of normal and cancer cells and induces their differentiation

ALSO: influences immune cell function, inhibits renin synthesis, increases insulin production & increases myocardial contractility (in studies in cells and animals)

</td></tr>
<tr><td>Vitamin E</td><td colspan="2">

No defined metabolic function
Lipid-soluble antioxidant, suggested to protect cell membranes against oxidative damage by free radicals

</td></tr>
</table>

Vitamin K	• Required for normal blood clotting
	  ○ Co-factor for vit K-dependent carboxylase
	  ○ 7 vitamin-K dependent clotting factors must undergo gamma carboxylation to become active
	  ○ Vitamin K becomes oxidized during the reaction, and must be reduced to participate in rxn again
	  ○ Warfarin inhibits vit K reduction → reduces synthesis of vit-K dependent clotting factors
	• Other vitamin K dependent proteins:
	  ○ Osteocalcin: formed by osteoblasts under influence of vit D; may be involved in mineralization
	  ○ Matrix Gla protein: may prevent calcification of soft tissues

6. Describe the condition produced by deficiency of each of the vitamins, including the major symptoms, and explain the circumstances under which this might occur.

Vitamin A	• Not common in N. America • In N. America, most often seen in chronic diseases associated with fat malabsorption or in conditions associated with impaired storage (ex// liver cirrhosis) • Develops slowly in adults (liver stores maintain plasma levels for up to 2 years), but much more rapidly in children		
	Symptoms	Eye	• Retinal dysfunction leading to progressive reversible night blindness • Xerophthalmia: changes in structure & function of epithelial cells ○ Conjunctival & corneal xerosis (dry, wrinkled, hazy) → corneal ulceration, scarring → blindness
		Other	• Decreased resistance and increased morbidity & mortality due to infections • Loss of functional, mucous-secreting epithelial cells ○ Increased susceptibility to respiratory infections, rash, diarrhea

Vitamin B	Thiamin (B1)	Dietary deficiency	• In Western countries, risk increased in:
			  ○ Alcoholics
			  ○ Diuretic-induced in elderly (excess excretion)
			  ○ Heart failure

		Beriberi	• Either neurological (peripheral neuropathy) and/or cardiac sx • Occurs in prolonged dietary deficiency
		Wernicke's encepha-lopathy	• Occurs mostly in alcohols • If suspected, immediate treatment with thiamine is required • Symptoms include abnormal eye movements & motor abnormalities • Can progress to Wernicke-Korsakoff syndrome w/ dementia & psychosis
	Riboflavin (B2)	• Uncommon and rarely occurs alone due to efficient re-cycling of riboflavin • Symptoms: cheliosis and angular stomatitis (cracks & sores on lips & corner of mouth); inflammation and redness of tongue; skin rash; corneal vascularization; anemia	
	Niacin (B3)	• Known as pellagra • Symptoms: dermatitis, diarrhea, dementia	
	Pyridoxine (B6)	• Uncommon, may occur in alcohols, malabsorption diseases ○ Symptoms: dermatitis, neuropathy, anemia • Drug-induced (ex// isoniazid): associated with sensory neuropathy	
Vitamin C	Severe (scurvy)	• Uncommon: elderly, alcohols, drug addicts and those with very poor diets at risk • Symptoms (mild): anorexia, weakness, fatigue, irritability • Symptoms (severe): red & swollen gums, loose teeth, anemia, hemorrhage	

Vitamin D	Deficiency	• <u>Children:</u> Rickets – failure to mineralize new bone & cartilage matrix
		  ○ Results in soft bones, deformed joints & increased susceptibility to fracture
		• <u>Adults</u>:
		  ○ *Osteomalacia:* ↓ bone density & mineralization, muscle weakness, bone pain
		  ○ *Osteoporosis* & increased risk of fractures	

	Risk of deficiency	• At Vancouver's latitude (49° N) UVB radiation too low for vit D production in skin from mid-October to mid-March ○ During remainder of year, short periods of sun exposure should produce adequate vitamin D (depending on factors such as sun intensity, skin color, age) • 4% of Canadians considered vit D deficient; 10% vit-D insufficient
	Risk increased in	• Exclusively breastfed infants • Elderly • Covering all exposed skin or using sunscreen (SPF ≥ 8) whenever outside • Dark skin pigmentation • Fat malabsorption syndromes and inflammatory bowel disease • If renal production of 1,25-(OH)D_3 is impaired

	Impaired production of calcitriol	• Ex// renal osteodystrophy, hypoparathyroidism, vit D-dependent rickets
		  ○ Calcitriol: active form of vitamin
		  ○ Alfacalcidiol: already hydroxylated in 1α position (25 position)

Vitamin E	• Normally symptomatic dietary deficiency is not seen • Neurological sx and anemia responsive to vitamin E found in premature infants & in children with fat malabsorption syndromes	
Vitamin K	• Hypoprothrombinemia → increased tendency to hemorrhage	
	Risk of deficiency	• Newborn: minimal stores; no established intestinal flora; breast-fed infants have limited dietary intake ○ Administration of a small dose of phytomenadione to newborn infants routine • After infancy: although limited storage, dietary deficiency is rare (supplied in diet; conserved by vitamin K cycle and is produced by intestinal bacteria) • Inadequate absorption: fat malabsorption syndromes

7. Describe the adverse effects associated with excess intake of each of the vitamins.

Vitamin A	• Intake > 1500 ug/d associated with decreased bone density & increased risk of fractures in adults
	• Chronic toxicity can occur on intake of 10-20 x the RDA for as little as 6 m in adults (less in children)
	  ○ Liver damage may occur; dry itchy peeling skin; increased intracranial pressure (children)
	• Acute toxicity (on ingestion of massive doses – 500 x the RDA in adults): severe headache & generalized peeling of skin (after 24 h)
	• Excessive intake of vit A during pregnancy (particularly first 2 months) increases risk of birth defects
	  ○ Women who are pregnant or planning to become pregnant should not take more than the RDA
	• UL for vitamin A: 3000 ug (10,000 IU/day) for adults
	  ○ Based on prevention of liver toxicity (decreased bone density not considered)
	• Toxicity of B-cartotene (not associated with vitamin A toxicity or teratogenicity)
	  ○ One sign of excess intake is yellow-orange skin
	  ○ Studies found increased risk of lung cancer in smokers and total mortality	

Vitamin B	Thiamine (B1)	• No UL; no known toxicity on oral intake
	Riboflavin (B2)	• No UL; no known toxicity • High-dose colors urine fluorescent yellow

	Niacin (B3)	• Nicotinic acid: flushing of skin (primarily face, arms, chest)
		  ○ Flushing with nicotinamide is rare
		  ○ UL for niacin (both nicotinic acid & nicotinamide) set at 35 mg/day to avoid it
		• Other SEs: pruritus; GI distress; abnormal liver function
		  ○ Most common when used in high doses for treatment of hyperlipoproteinemia

	Pyridoxine (B6)	• Sensory neuropathy with intakes > 200 mg/day for several months • UL = 100 mg/day for adults

Vitamin C	• Generally well-tolerated • UL for adults = 2g/d • High doses (>4 g/d) → osmotic diarrhea & GI disturbances ○ Avoid high doses if history of renal stones or pre-existing renal disease or failure (may be aggravated by excess oxalate production)

Vitamin D	• Hypercalcemia → calcification of soft tissues; irreversible liver failure
	  ○ S/S: weakness and fatigue, headache, nausea, vomiting, diarrhea, impaired renal function
	• UL = 4000 IU/day in >9 years old
	  ○ Toxicity seen most often at doses > 10,000 IU/day

Vitamin E	• UL = 1,000 mg daily of alpha-tocopherol (any form)
	  ○ Based on possibility that high doses vit E may have anticoagulant activity & could cause hemorrhage
	  ○ Increased risk of bleeding has been observed with co-administration of vit E and warfarin

Vitamin K	• Phytomenadione generally non-toxic → no UL been established

8. Explain the therapeutic uses, if any, of each of the vitamins other than in the treatment of vitamin deficiency.

Vitamin A	Only used in the correction of vit A deficiency		
	Retinoids	• Natural and synthetic analogs of retinol (not all have vitamin A activity) • Used in dermatological conditions (ex// istotretinoin in severe cystic acne) • Prevention & treatment of epithelial cell cancers	
Vit B	Thiamine (B1)	• Prevention and treatment of thiamine deficiency • Other uses under investigation (diabetes, Alzheimer's)	
	Riboflavin (B2)	• Migraine prophylaxis (based on single small RCT of 400 mg/day) ○ NOTE: only 25 mg can be absorbed in a single oral dose	
	Niacin (B3)	• In pharmacological doses, nicotinic acid (NOT nicotinamide) decreases serum cholesterol and triglycerides	
	Pyridoxine (B6)	PMS	• 50-100 mg/day may be of benefit

		Morning sickness	• May be slightly beneficial in reducing N and/or V in pregnancy
			  ○ 25 mg every 8 hours for 3 days
			or
			  ○ 10 mg every 8 hours for 5 days

		No evidence for	• Prevention of side effects of low-dose oral contraceptives • Carpal tunnel syndrome • Depression • Mood or cognitive function in elderly
Vitamin C	CV disease	• No evidence of benefit in prevention of CVD	
	Advanced cancer	• Large oral doses (up to 10 g/d) of no benefit in treatment of advanced cancer • IV administration: can reach much higher blood levels but studies don't show benefit ○ Many CAM practitioners treat cancer pts with ≥ 25 g IV several times per wk	

	Common cold	• <u>Prophylactic use:</u>
		  ○ No evidence for reduction of *incidence* of colds in general population; may reduce in those exposed to severe physical exercise
		  ○ Slight reduction in *duration* of colds
		• <u>Therapeutic use:</u> no evidence of benefit	

Anti-oxidants	AMD (age-related macular degeneration)	• Combo of antioxidants (B-carotene, vit C, vit E) + zinc oxide → delay progression of AMD and loss of visual acuity in pts with *moderate-severe* disease ○ NOTE: combo w/o B-carotene as effective • No evidence that supplementation will prevent AMD	
Vit D	Osteoporosis	• Supplementation with 800 IU/day vit D (+ 1000 mg/day Ca) reduces risk of hip and non-vertebral fractures in older patients	

	Reduced risk of disease	• Insufficient evidence to support increased vit D to prevent cancer or other chronic diseases *unrelated to skeletal health* ○ Low vit D levels may be a marker for poor health status, rather than a cause of it
Vit E	Cancer & CV disease	• Results largely negative • Vitamin E supplements may be harmful (evidence of small increased risk of HF, MI, stroke, prostate cancer)
	Alzheimer's?	• One RCT showed delay in deterioration in pts with mild-moderate AD (2000 IU/day) • Another RCT found no effect of 2000 IU/day on rate of progression from MCI → AD
	Topical	• Suggested to improve wound healing and decrease scarring of skin ○ Not supported by clinical trials
Vit K	Antagonist	• To overcome excess effects of coumarin oral anticoagulants
	Newborns	• To prevent hemorrhagic disease of newborn
	Topical	• No evidence that it is effective in preventing or treating bruising

9. State the known physiological functions of calcium, zinc, and fluoride, and describe the consequences of their deficiency and excess intake and the use of supplements.

Calcium	Required for	• Current flow across excitable membranes • Muscle contraction, vesicle fusion and release • Blood coagulation • Formation, structure & remodeling of skeleton
	Sources	• Mainly from milk and dairy products; also green leafy veggies and salmon, sardines
	ADME	• Absorbed in intestine by active vitamin-D dependent transport & facilitated diffusion ○ Efficiency increases as intake decreases, in part due to activation of vit D • Stored in bones (>99% of body stores) • Excreted in urine – regulated by parathyroid hormone (PTH)
	Deficiency	• Common across all age groups • If chronic, may prevent attainment of peak bone mass and may contribute to accelerated bone loss & development of osteoporosis
	Toxicity	• UL ranges from 1000 mg/d (infants) to 3000 mg/d (adolescents) • Some studies suggested intake from supplements may contribute to small increase in risk of atherosclerosis and MI
	Requirements	• Range from 200-1300 mg/day (depending on age, gender and status)
Zinc	Function	• Essential co-factor for large number of enzymes ○ Required for cell growth, nucleic acid, carbohydrate and protein synthesis • Required for normal use of vitamin A
	Sources	• Widely available in food; more bioavailable from meat (esp. red meat) than plants
	Requirements	• 8 – 14 mg/day in adults

	Deficiency	• Dietary deficiency unusual but is more likely in:
		  ○ Vegetarians
		  ○ Conditions when absorption is impaired, such as in Crohn's disease
		  ○ In areas where unleavened whole wheat bread is a major dietary staple
		• Symptoms: growth retardation, hypogonadism, delayed wound healing, disturbances in taste and smell

	Excess	• Acute toxicity: NVD, gastric bleeding at intakes > 500 mg/day • Chronic excess: copper deficiency (>150 mg/day for > 6 weeks) • UL: 40 mg/day in adults
	Use in common cold	• Zinc supplementation (≥ 75 mg/day) may reduce *duration* but not severity of colds • Short-term use of zinc (< 5 days) not associated with severe adverse effects • Lozenges associated with unpleasant taste and nausea • Intranasal zinc associated with loss of sense of smell

Fluoride	Function	• Prevents dental caries (cavities) by: 1. Inhibiting plaque ○ May kill or inhibit bacteria, inhibits their ability to produce acid from carbs 2. Inhibiting demineralization and enhancing remineralization of tooth enamel ○ Incorporated into tooth surface making it more resistant to acid, and speeding remineralization
	Requirement	• AI: from 0.01 mg/day (infants) to 4 mg/day (adult men)
	Deficiency	• Increased rate of tooth decay • Dental cavities – initiated by demineralization of tooth surface by acids produced by sugar-fermenting bacteria
	Sources	• Major dietary source of fluoride is drinking water • Toothpaste, mouthwash often fluoridated • Also contained in many prepared drinks & food
	Excess	• Chronic excess during tooth formation: dental fluorosis (mottled enamel of teeth) • At higher doses: osteosclerosis (increase in bone density & calcification) • Acute toxicity: death from respiratory paralysis or cardiac failure
	Supplementation	• Not recommended for children living in areas with fluoridated water • Supplements before eruption of first permanent tooth generally not recommended ○ If used, total fluoride intake from all sources should be ≤ 0.05 – 0.07 mg/kg/d to minimize risk of dental fluorosis • If used, lozenges or chewable tablets are preferred forms of supplementation • Children 3-6 years of age should brush twice a day with "pea-sized" amount of fluoridated toothpaste

LECTURE 21 – POPULAR DIETS

1. List 3 reasons why people might consider dieting.
   - To improve athletic performance
   - To lose weight/improve appearance (concerns with body image due to social pressures)
   - To become healthier (physical health) - >60% of Cdns are "overweight" and obesity is a risk factor for many diseases

2. Describe:
   a. Why some diets are so popular
   - Obesity is an issue all over the world – by restricting intake, people lose weight
   - Huge industry – lots of media attention/marketing to get people interested
   - Some are very easy to follow – "avoid carbs"
   - Offer a plan/structure – don't have to think about/plan meals
   - Come in all shapes & sizes (something for everyone) – tailored to loosing wt, gaining muscle, diseases, etc
   - May ignore traditional dietary recommendations – "eat only steak, no potatoes"

   b. How you can identify a "fad diet".

   DOES IT:
   - Sound too good to be true? – promising extreme and rapid weight loss
   - Recommend only using a single food & unlimited quantities? – ex// the Cabbage Soup Diet
   - Eliminate entire food groups? – can potentially lead to nutritional deficiencies
   - Recommend specific food combinations?
   - Provide only anecdotal cases to support its effectiveness?
   - Require special products or specific supplements?
   - Lack a plan for long-term maintenance of weight loss?

- Recommends a very strict/rigid menu?
- Lack recommendations regarding exercise?
- Forget to mention:
    - Any additional costs for supplements, coaching, recipes, etc?
    - Risks associated with the diet plan?

3. Explain why it is important for a pharmacist to be aware of "popular" diets.
    - Are one of the most trusted and accessible HCPs and are uniquely positioned in the public eye
    - Can help contribute by being a resource to the public for general nutritional advice
    - Can work collaboratively with dieticians and understand when to refer patients
    - Provide access to and information on various nutritional supplements
    - Play a significant role as a HCP to pts with chronic disease where self-management is key (non-drug measures)

4. Identify & describe 5 popular diets (diet characteristics, theory, claims, potential benefits and risks).

a. The 5:2 diet (Mosley Diet)

Theory	• Intermittent fasting and/or energy restriction
	  ○ Lower energy intake accelerates fat/weight loss
	  ○ Forces the body to use up blood glucose, then stored glucose (glycogen), then fat stores

Claims	• Weight loss: 1 lb/week • Improves brain function • Reduces risk of heart disease, stroke, certain cancers, • Promotes longevity
Pros & health benefits	• Only need to count calories 2 days of the week • Can be flexible with meal plan on fasting days • Not restrictive in foods you can eat • Some studies do suggest health-related benefits with intermittent fasting

Cons & health risks	• Fasting SEs: dizziness, irritability, headaches, insomnia, bad breath, dehydration
	• If fasting for prolonged periods of time:
	  ○ Loss of lean body mass
	  ○ Potential for development of nutrient deficiencies
	• Not recommended in: pregnancy, diabetes, children/teens, eating disorders
	• Hard to follow – people feel hungry and may overeat on non-fasting days

Bottom Line	• Fasting days may be challenging and may not be sustainable
	  ○ Don't fast 2 days in a row
	  ○ Keep hydrated
	  ○ Eat nutritiously dense food on fasting days
	• Limited evidence for benefits (weight loss) and information on long-term effects is lacking

b. The Atkins Diet

The Diet	• Low carb (high protein) diet that has 4 phases • Refers to carb intake as "net carbs" = total carb content of food – fibre & sugar alcohols ○ # grams (net) impacts blood sugar levels • Atkins 20 (classic) and Atkins 40 (new Atkins)	

	Phase I (Induction)	• Minimum of 2 weeks duration and/or until at least 15 lbs from goal weight
		• Allowed only 20 g (net) carbs per day – must follow list
		  ○ Mainly fish, poultry, and other meats (devoid of net carbs)
		  ○ Also target 12-15 g (net) carbs from veggies (low starch)

	Phase II (Ongoing Weight Loss)	• Allowed 25 g (net) carbs per day and increase by 5 net increments/week
		  ○ Target range: 25 – 50 g net carbs / day
		• Must still follow the list
		  ○ Broader selection– can begin to add nuts, seeds, berries
		• Continue until wt stops going down, then remove 5 g net carb from daily intake until losing wt again
		  ○ Duration until 10 lbs of goal weight

	Phase III (Maintenance)	• Gradual increase in net carb by 5-10 g increments
		  ○ Target range: 50 – 80 g net carbs / day
		• Reintroduce new carbs as long as wt loss remains gradual & is maintained
		  ○ Continue this phase until reach goal weight & is maintained for 1 m

	Phase IV (Lifetime Maintenance)	• Add more carb sources back into diet – as long as weight doesn't increase ○ Target range: 80 – 100 g net carbs / day

Theory	• Overconsumption of refined carbs are the main reason for weight gain/obesity
	• Low carb diet triggers body to burn stored fat → weight loss (via ketosis)
	  ○ Loss of appetite, loss of bound water
	  ○ Eat more protein which is more filling	

Claims	• Weight loss occurs and is maintained
	  ○ Phase 1 = rapid weight loss (15 lbs in 2 wks)
	  ○ Phase 2 = 2-3 lbs loss
	• Improved heart health & brain function
	• Decreases risk factors for chronic diseases (CVD, diabetes)
	• Modified Atkins type of diets might also help prevent seizures in adults	

Pros	• Rapid weight loss in beginning • Feel less hungry so eat less overall • Might be easier to stick with compared to low fat diets • Easy to follow – can purchase premade bars, shakes, meals	
Cons / health risks	• SEs of limiting carbs: bad breath, nausea, tiredness, dizziness, insomnia, constipation • Carbs may be replaced with high fat, processed meat – may lead to other concerns (CVD) • Increased intake of protein may cause issues with kidney stones, osteoporosis? • Not recommended in pregnancy	
Bottom line	• Ok for short term use if weight loss occurs • Long-term efficacy effects on overall health & disease prevention are unknown • No clear evidence that it is better than any other weight loss plan • Hard to stick to long-term – can be complicated and time consuming to follow	

c. The Dukan Diet

The diet	• Overall low carb and high protein → can eat as much as you want of the approved foods • Oat bran supplementation and LOTS of water is recommended • Exercise is part of the diet routine • Composed of 4 phases ○ Alcohol only after reached phase 3 or 4	

	Phase I (Attack Phase)	• Usually lasts for 10 days
		• Lean protein (chicken, turkey, eggs, fish) is allowed – must be on approved list (68 listed)
		  ○ Unlimited portions
		• NO CARBS, including no veggies
		  ○ Only 1.5 tbsp oat bran is allowed
		• 6 cups of water daily
		• Walk 20 mins per day

	Phase II (Cruise Phase)	• Usually lasts for several months (3 days for each lb you want to lose) • Add non-starchy veggies (greens) every other day (unlimited) – list of 32 • 2 tbsp oat bran • Maintain water intake (6 cups/day) • Walk 30 mins per day
	Phase III (consolidation / transition)	• Duration depends on weight loss (lasts 5 days for every lb lost) • Add fruit, whole grain bread, hard cheese, starchy foods & "celebration meals" – all very limited and prescriptive in quantity • 2 tbsp oat brain; maintain water (6 cups/day) • Walk 25 mins per day
	Phase IV (stabilization/ maintenance)	• Can eat what you want for 1 day/week; must follow rules re: protein consumption outlined in Phase I • 3 tbsp oat brain • Maintain water (6 cups/day) • Walk 20 mins per day
Theory	• High protein – protein takes more time to digest, makes you feel fuller longer, has less calories per gram compared to carbs • Low carb – body will burn off fat stores if carb intake is limited	

Claims	• Weight loss: 4-7 lbs in attack phase, 2-4 lbs in cruise phase, then 2lbs/week
Pros/benefits	• Weight loss at beginning is fast • No need to count calories • Very prescriptive and thus easy to follow • Online coaching, books, recipes, supports • Relies on natural foods • Eat as much as you like of the allowed foods • Emphasis on lean protein

Cons/health risks	• SEs low carbs: tiredness, dizziness, bad breath, insomnia, dry mouth, constipation, lethargy
	• Potential for nutrient deficiencies
	  ○ Fiber supplement is required
	  ○ Recommendation to stay in early phases for too long
	  ○ Limit fruits and vegetables
	• Not a lot of variety
	• Can be an issue for diabetes (esp. first 2 phases due to low carbs), renal disease?, heart disease?, vegetarians (no beans, nuts, lentils), pregnancy, depression

Bottom line	• May see quick weight loss in beginning stages but unlikely unsustainable – doesn't change overall eating habits for long term • May regain weight lost when go back to normal eating • Could be in a phase for a long time that could lead to nutritional deficiencies

d. The Paleo Diet

The diet	• "Caveman" diet, based on Paleolithic era → food that can be hunted/gathered
	• In general: lean protein, fish, nuts, eggs, veggies, fruits
	  ○ Generally no upper/lower limits included – more about quality of food
	• Lots of variations
	  ○ Strict paleo – avoid dairy, grains, processed food, sugar, legumes starches, alcohol
	  ○ Low carb / high protein

Theory	• Today's health issues & diseases are a result of eating highly processed dense foods ○ Obesity, diabetes, heart disease, cancer, Parkinson's, Alzheimer's, depression • Exclude food that humans have not genetically "adapted" to • Increase lean protein = satiating and helps control appetite • Increasing healthy fats = decreases gastric emptying, full longer • Encouraging veggies and fruits = antioxidants, vits, minerals (good for chronic disease)
Claims	• Better athletic performance? • Weight loss quick in beginning and maintained (5-10 lbs in first wks, then 1-2 lb per week) • Reduces risk of diseases (diabetes, heart disease, cancer) • Anti-inflammatory?
Pros	• Wide range of food acceptable • Encourages eating of nutrient dense foods and less processed food • Rapid weight loss in short term (and is maintained) • Diet also recommends exercise • Fairly easy to follow/understand – don't need to count calories
Cons/ health risks	• Can be costly • Strict paleo excludes food groups (dairy & grains) and can be difficult to follow 100% • Can be an issue for: vegetarians
Bottom Line	• Antidote for Western Diet? • Can lose weight • High in protein and fibre – you shouldn't feel hungry and overeat • Exercise is highly recommended as an adjunct to diet • Recommends lifestyle changes and changes to eating habits – more likely to be maintained

e. The South Beach Diet

<table>
<tr><td>The diet</td><td>

Low carb, low sugar (high protein), high fibre, lean protein and unsaturated fats
Allows certain carbs based on their GI
Recommends 3 meals a day + 2 snacks
3 phases – gradual increase in carbs, while decreasing proportion of fat & protein
No restrictions on calorie intake
Recommends exercise

<table>
<tr><td>Phase I (Body Reset)</td><td>

Designed to try to eliminate cravings for sugary food/refined starches and jump start weight loss
Structured – 3 meals a day, 2 snacks, dessert
Cut out almost ALL carbs (avoid bread, rice, potatoes, pasta, sugary foods)
Lean meats, nuts, beans, veggies
Usually lasts 2 weeks

</td></tr>
<tr><td>Phase II (Steady Weight Loss)</td><td>

Aim is to be the longer term weight loss phase
Maintain this phase until reach goal weight
Some carbs are reintroduced in moderation (fruit, whole grains, veggies)
Approach is structured – one singe carb reintroduced for 1 meal/day/week & response is monitored
Continue if tolerated & until 2-3 servings of right carbs introduced to daily meal plan
If revert back to old unhealthy eating or weight regained, go back to phase I

</td></tr>
<tr><td>Phase III (You Got This)</td><td>

Start when target weight reached – aim to be maintenance phase
Adopting the lifestyle of making good food choices & maintaining weight loss, and eating foods in moderation
Choose right carbs – up to 140 g carbs / day
If cravings return/weight regained, go back to an earlier phase

</td></tr>
</table>
</td></tr>
<tr><td>Theory</td><td>

Eating carbs with a higher GI increases blood sugars faster and for longer periods of time
Stimulates appetite and causes people to overeat
Key to weight loss is eating the right carbs/fats
Eating “good” carbs can keep metabolism and sugar levels steady (not constantly spiking/fluctuating)

</td></tr>
<tr><td>Claims</td><td>

Weight loss (and maintenance): 8-13 lbs in phase I; 1-2 lbs/wk in phase II
Prevents some chronic diseases (diabetes, heart disease)

</td></tr>
<tr><td>Pros</td><td>

Promotes consumption of veggies, lean meats and restricts fatty meats, cheeses & sweets
No need to count calories so easy to follow for some

</td></tr>
<tr><td>Cons / health risks</td><td>

SEs of low carbs: bad breath, tiredness, dizziness, insomnia, nausea, constipation
First phase has lots of restrictions and can be hard for some
Weight loss may be regained when eat normally
Lacks dietary fibre

</td></tr>
<tr><td>Bottom line</td><td>

May be challenging to get through first phase
May be ok for short-term weight loss
No data on long-term safety and efficacy for weight loss maintenance and health related outcomes/benefits

</td></tr>
</table>

5. List some common components (principles) of a “good” diet plan.

- Easy to follow/maintain
- Focuses on healthy eating and exercise as regular habit
- Recommends nutrient-dense, high-fiber foods more often
- Limits alcohol, sugar, fat
- Has reasonable goals: decrease overall calorie intake, fat intake, exercise regularly; 0.5 – 2 lbs/wk (10-20 lbs/yr)
- Promotes long-term weight loss & maintenance and describes ways to achieve this
- Emphasizes improvements in quality of life as a success too

6. Identify reasonable approaches to achieve and maintain a healthy body weight.
   - Make well balanced health food choices – choose nutrient-dense and fibre-rich foods more often
   - Avoid over-processed foods
   - Be realistic about overall energy intake – energy out > energy in by 500 kcal/d for weight loss
   - Be mindful of portion size
   - Limit fat intake to 20-35% of total calories & choose healthy fats more often
   - Use little added sugar or additional salt
   - Alcohol use in moderation
   - Exercise regularly
   - Slow down – faster eating >> higher energy intake >> increase body weight
   - Drinks LOTS water
   - Set goals
   - Plan meals ahead of time

LECTURE 23 – DRUG-NUTRIENT INTERACTIONS & ENTERAL FEEDING

1. Identify and suggest appropriate resolution of the select drug-nutrient and drug-enteral food interactions presented on the lecture slides.

Types	• Chemical: binding the drug and decreasing its absorption • Physical: adsorption of drug and nutrient (or feed formulation) → blockage ○ Ex// sucralfate and enteral feed • Interaction between drug and a specific nutrient involved in the drug's metabolism
Pantoprazole	• Possible to use via NG tube (crush and dissolve tablet) • Consider parenteral route or changing therapy to lansoprazole or omeprazole

Ciprofloxacin	• Ciprofloxacin binds to divalent ions in the feed (reduced absorption)
	  ○ Try administering dose during a break in feeding where possible
	  ○ Alternatively consider alternative quinolone (interaction is less)
	• Ciprofloxacin 750 mg tablets can be crushed and dissolved (delivered via gastric tube)
	• Suspension (granules) = very thick, non-aqueous so high risk of tube blockage with fine tubes

2. Discuss indications and contraindications for enteral feeding.

Indications	• Patient with a functional GIT but where oral intake is unsafe, insufficient, or impossible
	  ○ Support maintenance of functional integrity of gut
	  ○ Nutrients undergo first-pass metabolism	

Contraindications	Absolute	Possible
	• Necrotizing enterocolitis • Bowel obstruction • Hemodynamic instability	• Persistent vomiting or diarrhea • Acute abdominal distension • Fistula (gastric, small or large bowel) • Upper GI bleeding

3. Compare and contrast the different types of enteral formula.

Polymeric	• Most common type • Least expensive • 1.5 – 2 L/day provides 100% RDA for vitamins/minerals • Require full digestive function for proteins, carbs and fats			
	Caloric density	**Nutrient source**	**Fibre-content**	**Protein content**
	• Standard: 1-1.2 kcal/mL • Mod: 1.5 kcal/mL • Dense: 2kcal/mL	• Milk-based • Lactose-free • Blenderized	• Fibre-free • Low-mod (1-8 g/L) • High (>8 g/L)	• Low: nitrogen 6% of kcal • Standard: 11-15% • High: 16-25%

Oligomeric	• Require minimal digestive function for proteins and medium-chain triglycerides
	  ○ Often contain free amino acids
	  ○ Some pancreatic enzyme activity required for digestion of fats and oligosaccharides
	  ○ Some brush border disaccharidase activity required
	• Leave little residue in the colon
	• Often used for patients with severe pancreatic insufficiency or short-bowel syndrome	

Specialized	Renal failure	• Low-protein, low electrolytes • Enriched with essential amino acids
	Hepatic failure	• Contain 45-50% of protein as BCAAs (vs. 15-20% in standard formulas)
	Glucose control	• Lower carb, higher fat (ex// glucerna)
	Stress/ critically ill	• Designed for hypermetabolic patients (ex// high nitrogen content)
	Pulmonary	• Increased percentage of calories from fat

4. Compare and contrast the different types of enteral tubes with respect to size, material type, and placement and the benefits/ disadvantages of each for the patient.

Feeding Tube Size	• External diameter of the feeding tube is measured in the French (Fr) unit ○ 1 Fr = 0.33 mm		
Feeding tube position	Nasogastric (NG)	• Inserted via nose & exits the stomach • Size can vary (6 – 16 Fr); length 90 – 100 cm	• Inserted via nasopharynx • Used for days to weeks
	Nasoduodenal (ND)	• Inserted via nose & exits in duodenum; usually with endoscopic or radiological imaging	
	Nasojejenual tube (NJ)	• Inserted via nose & exits in jejenum • Usually inserted radiologically or endoscopically to ensure correct positioning • Length: 150 cm = prone to blockage • Lack of evidence re: drug absorption from this site	
	Percutaneous gastrostomy	• Inserted via abdominal wall into stomach (usually endoscopically) • Held in place with internal balloon & external fixator	• Direct access to GIT through skin • Used for months to years
	Percutaneous jejunostomy		
Material Type	Selection varies with	• Intended duration of use • Part of GIT that the feed is delivered to	
	Materials	**Advantages**	**Disadvantages**
	Polyurethane **Polyvinylchloride**	• More rigid • Less flexible	• Larger internal diameter compared to latex/silicone tube of same Fr size
	Silicone **Latex**	• Softer • More flexible	• Requires thicker wall to prevent stretch/ collapse

5. Discuss the different types of enteral feeding products and their advantages and disadvantages.
???

6. Discuss the general considerations for administering medications through enteral feeding tubes.

Implications for drug administration	• Size of lumen & length of tube – narrow and/or long tubes more likely to become blocked
	• Site of drug delivery:
	  ○ Different pH
	  ○ Delivery beyond site of absorption
	  ○ Reduction in duration of contact with GIT
	  ○ SE may be increased due to rapid delivery of drug to lumen of small bowel

Tube blockage due to	• Small internal diameter of tube • Poor flushing technique or regimen • Gastric acid, feed and medication interactions • Inappropriately prepared medications (ex// inadequately crushed tablets)
Medication administration key points	• Consider if patient may be able to take some medications orally • Avoid adding medications directly to enteral feeding formula • Avoid mixing crushed or liquid medications together prior to administration • Change to medications with longer $t_{1/2}$ but avoid use of modified/slow-release medications • Monitor for changes in therapeutic response

7. Discuss specific medication and dosage form considerations for their administration through enteral feeding tubes.

		Advantages	Disadvantages
Liquid	Solutions	• Ready to use • Accurate dosing	• Co-solvents may have p'col effect if present in sufficient quantities (ex// sorbitol > 15 g/d)
	Suspension	• Usually ready-to-use	• Shorter stability/shelf-life • Requires adequate shaking for accurate dosing • Further dilution usually required (viscosity)
		KEY POINTS: • Granules in suspension may be too large to pass through feeding tube (ex// ciprofloxacin, clarithromycin, lansoprazole) • Suspension may be too viscous to pass through feeding tube	
Solid		**Advantages**	**Disadvantages**
	Soluble Tablets	• Drug is in solution for admin • Long expiry date • Often less costly than liquid	• Time for complete dissolution required
	Effervescent Tablets	• Long shelf-life • Less costly than liquids	• Larger volume of water required • Time for dispersion • Sodium content may be too high • Production of CO_2 makes syringe administration difficult
	Tablets	• Cheap (often) • Easily obtained • Most disintegrate in water • Crushing maybe unnecessary	• Not all tablets disintegrate easily (require crushing) • Crushing EC tablets will likely block tube; also absorption may be decreased
	Capsules	• Cheap • Often convenient (hard)	• Occupational exposure • Small capsules difficult to open
		CAPSULE TYPES: • Hard gelatin: open and contents mixed with water • Soft gelatin: usually contain oil; poorly soluble in water	

LECTURE 24 – TOTAL PARENTERAL NUTRITION

1. To understand when TPN should be initiated.
   - Inability to absorb adequate nutrients enterally (massive small bowel resection, severe malabsorption, severe vomiting/diarrhea, radiation enteritis)
   - Bowel rest (ex// moderate to severe pancreatitis, IBD)
   - Severe malnutrition with non-functional GIT
   - Time frame
     - Non-usable GIT x 5-7 days
     - Within 1-3 days if severely malnourished with non-functioning GIT (i.e. cannot feed enterally)

2. To be able to assess a TPN formula:

Basal Energy Expenditure (BEE) x stress factor	kCal/kg/day
Maintenance x 1.2 – 1.3	No stress: 20 – 25
Surgery*, minor infection x 1.5	*Mod Stress: 25-30
Major surgery, sepsis, tumor x 1.5 – 2.0	Severe stress: 30-35

BEE calculations: ht (cm); wt (kg); age (years)

- Males: 66 + (13.7 x wt) + (5 x ht) – (6.8 x age)
- Females: 665 + (9.6 x wt) + (1.7 x ht) – (4.7 x age)

NOTE: use IBW as basis of calculations (formula on cheat sheet provided) unless:

a) ABW > 120% IBW → use 25% of difference added onto IBW ((ABW-IBW) 0.25 + IBW))

b) ABW < IBW → use ABW

a. Macronutrients (carbohydrate, protein, fat) – requirements provided on exam!

Protein (4 kCal/g)	Estimated requirements	• Maintenance (healthy, unstressed): 0.8 – 1 g/kg/day • Moderate repletion (surgery, trauma): 1.5 g/kg/day • Extensive repletion (burn): 2 – 2.5 g/kg/day
	Complications	• Pre-renal azotemia (increased BUN)
Dextrose (3.4 kcal/g)	Max requirement	• 7 g/kg/day (5 mg/kg/minute) • 50 – 60% of total calories
	Complications	• Synthesis & storage of fat (abnormal LFTs - ↑ AST, ALT) ~ 2-3 wk • Hyperglycemia: monitor blood glucose • Increased CO_2 production
Lipids/fat (2kcal/mL)	Formulation	• Only one formulation (20%) ○ 250 mL contains 4 mmol PO4 & 133 mcg vit K • Contains egg phospholipids
	Requirement	• 20-30% total calories (> 4% ; <60%) • Try for < 1 g/kg/day (max 2 g/kg/day)
	Complications	• Pancreatitis • Increased triglycerides (< 4.5 mmol/L) • Fat overload syndrome (accumulation in RES system of liver)

b. Micronutrients (electrolytes, vitamins, trace elements). NOTE. You will NOT be responsible for determining amount of micronutrients to add to TPN.

Electrolytes • Na chloride/ acetate • K chloride/acetate • Calcium gluconate • Magnesium chloride • PO4 (Na or K salt) • Chloride & acetate	Special requirements	• Renal failure • Diuretic use • Amphotericin B • Refeeding syndrome • High fistula output
Multivitamins	Need	• Necessary for normal metabolism and cellular function • Do not contain vit K (only add if intralipid < 200 mL/d) or iron (add iron dextran if > 1 mo)
	Special requirements	• Bursn/Ig wounds: vitamin C • Alcoholic: thiamine, folic acid • Refeeding: thiamine, folic acid (coenzymes for carb metabolism)
Trace Elements • Cr, Cu, I, Mn, Se, Zn	Need	• Essential for proper functioning of several enzyme systems

	Special Requirements	• Extra zinc:
		  ○ Burn/large wounds
		  ○ High fistula output/excessive diarrhea

3. To know how to start and monitor patients on TPN.

Fluid requirements	• Increased in fever, fistulas, diarrhea, NG suction → may require separate IV for replacement • Decreased in: renal failure, CHF, cirrhotic ascites, pulmonary disease → concentrate macronutrients (dextrose 70%)	
Monitoring	• *Daily x 5, then twice weekly:* electrolytes, glucose QID, phosphate, magnesium • *Twice weekly x 2, then weekly:* albumin, calcium, urea, creatinine • *Weekly:* CBC, INR, PTT, triglycerides, LFTs (alk phos, ALT, AST, GGT) • *Other*: weights twice weekly; if on insulin, glucometer QID; other meds/conditions that can affect glucose	
Feeding techniques	**Advantages central line**	**Disadvantages peripheral line**
	• Hypertonic solution okay • More balanced formulas • Long-term TPN	• Max osmolality = 600-900 mOsm/L ○ Dextrose 10% = 505 mOsm/L • Major calories from FAT
Discontinuing TPN	Without taper	• Once patient tolerates DAT and is taking 50% calories PO or enterally • Stop TPN by ↓ infusion rate by 50% x 2 hrs, then D/C (VGH)
	With taper	• Abrupt discontinuation (ex// CV sepsis and no other carb source) • Taper with D5-10W via peripheral line x 2-4 hours

4. To understanding major complications associated with TPN and their management

a) Refeeding

Description	• Occurs when acute provision of macronutrients (particularly carbs) that promote <u>anabolism</u> in patients who are malnourished
	  a) With starvation, body switches from using carbs to fat & protein as main energy sources
	  b) With re-introduction of carbs (TPN) → sudden sift back to glucose as predominant energy source
	  c) Leads to insulin surge → anabolism → intracellular shift of **K, PO4, Mg**
	• Also need extra **thiamine, folic acid**

Initiating TPN	• Start with 15-20 kCal/kg/day (~ 50% of nutritional needs) ○ Reduce carbs and fat, okay to give more protein • Increase to goal over 3-7 days
Electrolyte abnormalities	• <u>Treatment of current situation</u>: give IV boluses of K, P04, Mg • <u>Prevention:</u> add extra K, P04, Mg to TPN bag ○ Monitor electrolytes daily x 5, then twice weekly

b) Hyperglycemia

Diabetic pts	• Reduce initial dextrose to max 100-150 g on day 1 (adjust fat & AA appropriately) ○ Increase slowly based on tolerance • Continue basal insulin (ex// glargine, NPH) at full or 2/3 dose • Initiate insulin sliding scale orders (shorter-acting insulin; ex// regular or lispro)

Adding insulin to TPN	• Only regular insulin is compatible with TPN
	  ○ Common starting point: 0.1 units/g dextrose (i.e. 30 units for 300 g dextrose)
	or
	  ○ Add up total insulin given by sliding scale over 24 hrs and add 1/2 – 2/3 to TPN
	• Why not add full amount of sliding scale insulin into TPN bag?
	  ○ Different routes of administration (TPN is IV, not SC)
	  ○ Safer to run sugars slightly higher than lower

Other causes of hyper-glycemia	• Infection/sepsis • Corticosteroids • Stress – ACTH induces gluconeogenesis • Excessive dextrose administration

c) Elevated liver enzymes

TPN & Liver Function	Liver function changes	• Mildly elevated transaminase (AST, ALT) and alkaline phosphatase levels usually occur 2 weeks (range 1-4 weeks) after TPN is started
	High-risk pts	• Pre-existing liver disease • Pre-existing malnutrition • Sepsis • Extent of bowel resetion • Excess non-protein calories • Little or no oral intake • Duration on TPN
	Drugs	• Octreotide, ceftriaxone → cause biliary sludging
Cholestasis	Description	• ↑ GGT, alk phos, bilirubin may reflect cholestasis (gallbladder sludge) • Major risk factor = duration of TPN ○ Lack of nutrition in bowel → impaired bile flow

	Management	• Avoid overfeeding
		• Encourage oral/enteral intake (stimulates release of CCK → secretion of bile from gallbladder)
		• If prolonged therapy necessary:
		  ○ Cycle TPN (ex// 12 hrs on; 12 hrs off)
		  ○ Ursodiol 15 mg/kg/day in 2 divided doses (bile acid)
		• Uncomplicated TPN-related cholestasis usually resolves within 1-4 months after stopping TPN

Fatty liver (hepatic steatosis)	Description	• Elevated transaminases (AST, ALT) within 2-4 weeks after TPN initiated • Most commonly caused by excessive carbs (>7 g/kg/d) or overfeeding
	Management	• Avoid overfeeding; reduce carbs • Switch to enteral feeding ASAP • Cycle TPN