

Development of a Dietary Management Care Map for Metabolic Syndrome

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ABSTRACT

Metabolic syndrome (MetS) refers to a particular cluster of metabolic abnormalities (hypertension, dyslipidemia, type 2 diabetes, and visceral fat deposition) that can lead to a 1.5- to 2-fold increased relative risk of cardiovascular disease. Various combinations of healthier eating patterns and increased physical activity have been shown to improve metabolic abnormalities and reduce MetS prevalence. Dietitians who counsel MetS patients are challenged to integrate guidance from various medical management guidelines and research studies with effective behavioural change strategies and specific advice on what food and eating pattern changes will be most effective, feasible, and acceptable to clients. As part of a demonstration project that is currently underway, we developed a care map (decision aid) that represents the key decision processes involved in diet counselling for MetS. The care map is based on evidence from both clinical and health behaviour change studies and expert consensus and has undergone limited dietitian review. It is being used to help project dietitians clearly articulate their specific food intake change goals. Additional studies to directly compare counselling strategies could inform future development of the map. In the meantime, dietitians may find this care map helpful in clarifying counselling goals and strategies in this client group.

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RÉSUMÉ

Le terme « syndrome métabolique » (SM) fait référence à un groupe particulier d'anomalies du métabolisme (hypertension artérielle, dyslipidémie, diabète de type 2 et dépôt de graisse viscérale) qui peuvent faire augmenter de 1,5 à 2 fois le risque relatif de maladie cardiovasculaire. Or, il a été démontré que diverses combinaisons d'habitudes alimentaires plus saines et de niveaux accrus d'activité physique améliorent les anomalies du métabolisme et réduisent la prévalence de SM. Les diététistes qui conseillent les patients atteints de SM doivent intégrer les recommandations de diverses études et directives de prise en charge médicale à des stratégies efficaces de modification du comportement et à des conseils précis sur les changements alimentaires les plus efficaces, réalisables et acceptables pour les clients. À l'occasion d'un projet-pilote en cours, nous avons mis au point un plan de soins (aide à la décision) qui représente les processus décisionnels clés utilisés pour la consultation en diététique relative au SM. Le plan de soins est basé sur des données probantes provenant d'études cliniques, d'études sur les changements de comportements relatifs à la santé ainsi que du consensus des experts, et il a fait l'objet d'un nombre limité d'évaluations par des diététistes. Cet outil est employé afin d'aider les diététistes du projet à définir clairement leurs objectifs précis en ce qui a trait aux modifications de l'apport alimentaire. D'autres études visant à comparer de manière directe des stratégies de consultation pourraient orienter le développement futur du plan. Entre-temps, les diététistes pourraient trouver ce plan de soins utile pour clarifier les objectifs et les stratégies de consultation pour ce groupe de soins.

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INTRODUCTION

Metabolic syndrome (MetS) refers to a cluster of common abnormalities consisting of at least three of the following: elevated waist circumference, high blood pressure, high fasting

glucose, high triglycerides, and/or low HDL-cholesterol [1]. The presence of MetS leads to a 1.5- to 2-fold increased relative risk of cardiovascular disease (CVD) [2] beyond that expected from a typical Framingham Risk Score calculation [3].

In Canada, the prevalence of MetS is 19% among adults (18 years of age and older) overall and 40% among those aged 60 years and older [4]. No one combination of abnormalities predominates. Those with MetS represent a high-risk group who can benefit from secondary prevention lifestyle interventions to alter the trajectory to development of CVD.

Lifestyle modification, consisting of dietary changes and increased physical activity, can be effective in modestly improving the metabolic abnormalities and reducing the prevalence of MetS [5]. Most of the published trials have used a combination of diet and exercise with a goal of $\geq 5\%$ weight loss; however, the dietary interventions have varied considerably including a Mediterranean diet, the Dietary Approaches to Stop Hypertension (DASH) diet, and individually prescribed diets such as in the U.S. Diabetes Prevention Program (DPP) [5]. Evidence for a reduction in diabetes incidence has been demonstrated, but evidence for longer term changes in CVD morbidity and mortality is currently inconsistent and studies are ongoing [6, 7].

In Canada, practice guidelines developed by the Cardiometabolic Risk Working Group recommend health behaviour modification as the primary treatment strategy, consisting of counselling regarding physical activity, decreased caloric intake, and a diet based on Canada's Food Guide [2]. Other practice guidelines developed for management of specific features of MetS include a lower sodium DASH diet to prevent and control hypertension [8]; a Mediterranean, Portfolio, or DASH diet to improve lipid profiles and decrease cardiovascular risk [9]; control of the types, amounts, and timing of carbohydrate (CHO) intake to improve blood glucose control in people with diabetes [10]; and lifestyle modification programs to achieve a modest weight loss [11].

The challenge of implementing these multiple practice guidelines in dietetic practice is compounded by the need to incorporate behavioural strategies and individualize counselling to promote long-term dietary change. A national demonstration project involving 300 patients across three provinces was planned, where local Registered Dietitians (RDs) provide intensive diet counselling (weekly for the first 3 months and monthly thereafter) in conjunction with medical management and physical activity training with a kinesiologist in team-based primary care practices (ClinicalTrials.gov Identifier: NCT01616563). This led to consideration of how to best represent key decisions involved in diet counselling for MetS, while supporting RDs in their individualized counselling. Care maps, process algorithms, and other similar decision aids are used in many health care contexts to provide a graphical representation of typical decision processes. In dietetics, some evidence-based nutrition practice guidelines include such tools to guide care [12]. We were unable to locate a published algorithm for diet counselling in MetS and therefore undertook development to guide RD practice in the planned demonstration project, building on our previous work in developing a dyslipidemia care map [13].

CARE MAP DEVELOPMENT PROCESS

Evidence review

A narrative literature review was conducted to identify dietary patterns and specific dietary components that impact metabolic abnormalities common to MetS. The review identified common dietary patterns promoted through the relevant practice guidelines for obesity, diabetes, hypertension and dyslipidemia (e.g., Canada's Food Guide, Mediterranean diet, Portfolio Diet, DASH diet) [2, 8–11]; as well as evidence for specific diet components that could affect blood lipid profile or blood pressure [14] (see Table 1).

Review by dietitians

We first developed a draft version of the care map as a research group, and eight practicing RDs (from Quebec, Ontario, and Alberta) reviewed it for face validity. Several iterations of the care map were developed based on feedback from the RDs.

Heuristic evaluation

A specialist in heuristics (Knowledge Translation Consultation Service, St. Michael's Hospital Toronto) examined the care map to assess how well it followed usability principles [15]. The document was examined for consistency, organization, clarity of information, aesthetics, layout, legibility, and structure of the text. Suggestions included: using common colour-coding and shapes to represent the same activity, numbering the steps in the process, and using solid box outlines to emphasize main decision points. After revising the care map, 10 additional RDs external to the project provided further anonymous paper review.

USING THE CARE MAP

The current version of the care map is shown in Figure 1, outlining the numbered steps and decision points to consider in managing MetS. The initial assessment and counselling to define client goals assumes one-on-one RD–client interaction. An explanation of the rationale and key points follows (the numbers correspond to numbered steps shown in the care map):

1. Nutrition Assessment

In addition to standard nutritional assessment (i.e., anthropometric measurements, biochemical measures, weight history, and social/dietary history), assessment of intention and potential barriers to lifestyle change are considered when promoting weight loss and health behaviours [16, 17].

Assess and address intention: Assessment of intention is core to the assessment of readiness for most behaviour change processes. The Transtheoretical Model (TTM) [18] is popular among health care practitioners as it explicitly focuses on the concept of “Stages of Change” (SOC), allowing for different approaches depending on the stage. In diet behaviour, the “stage” for one behaviour may be different than for another (e.g., eating more vegetables vs. avoiding salty foods). RDs indicated that assessing intention needs to be done at several points in the initial assessment and goal-setting phases as

Table 1
Management of dyslipidemia or hypertension

Metabolic abnormality	Diet/lifestyle therapy
Elevated LDL-cholesterol	<ul style="list-style-type: none"> • Fat quality: decrease trans and saturated fat (<7%–10% of calories)^a, increase monounsaturated fat (increase nuts^b) • Increase soluble fibre (10–25g/day)^c • Increase plant sterols (2 g/day)^d • Increase vegetables and fruit (7–10 servings/day according to age and sex)^e • Increase plant protein (50 g/day soy protein)^f • Portfolio diet^g, Mediterranean diet^h • Weight reduction if overweight • Increase physical activity
Elevated triglycerides	<ul style="list-style-type: none"> • Balanced meals • Regular meals • Fat Quality: decrease trans and saturated fat^a • Increase omega-3 fat (1g/day EPA and DHA from fish, fortified foods, and/or supplements). (A dose of 2– 4 g/day EPA and DHA under the supervision of a physician could be considered as a component of medical management for adults with extreme hypertriglyceridemia).^a • Decrease sugars and refined carbohydrate^a • Alcohol abstinenceⁱ • Weight reduction if overweight • Controlling blood sugars if prediabetes or diabetes present • Increase physical activity
Low HDL-cholesterol	<ul style="list-style-type: none"> • Fat quality: decrease trans fat, increase monounsaturated and omega-3 fat^a (increase nuts^b) • Moderate alcohol intake (if triglycerides are not substantially elevated)ⁱ • Increase vegetables and fruit^e • Increase plant protein^f • Weight reduction if overweight • Smoking cessation • Increase physical activity
Elevated blood pressure	<ul style="list-style-type: none"> • Reduce sodium^j: <ul style="list-style-type: none"> ◦ ≤1500 mg (65 mmol)/day if ≤50 years of age ◦ ≤1300 mg (57 mmol)/day if 51 to 70 years of age ◦ ≤1200 mmol (52 mmol)/day if >70 years of age • DASH eating plan (increase vegetables and fruit, increase fibre, increase nuts, increase low fat dairy)^k • Moderate alcohol intakeⁱ • Weight reduction if overweight • Increase physical activity

^aFat quality: Reducing trans and saturated fat (SFA) (<7–10% of calories) can achieve reductions in LDL cholesterol (LDL-C) (up to 16%) and triglyceride levels (~8%) [38]. Replacing SFA with unsaturated fatty acids (PUFA or MUFA) rather than refined carbohydrates has been associated with reduced CVD risk [39, 40]. Omega-3 fatty acids from fish or fish oil supplements (approximately 3 g/day EPA and/or DHA) can reduce serum triglyceride levels by 10–33% [41].

^bNuts: Consumption of 50–100g nuts five times or more per week can lower LDL-C (~7%) and triglyceride levels (~10%), particularly in individuals with elevated LDL-C and blood triglyceride levels [42]. The potential for weight gain is a concern if additional calories are not compensated for.

^cSoluble fibre: Viscous or soluble fibre (7–10 g/day), including psyllium supplements and β-glucan from barley and oats, can reduce total and LDL-C (~7%) [43, 44].

^dPlant sterols: Foods enriched with plant stanol or sterol esters (providing an intake of about 2 g/day) can lower serum LDL-C levels by about 9%; however, an individual's LDL response can vary depending on their baseline LDL-C level [45].

^eVegetables and fruit: Consuming a diet rich in fruit and vegetables contributes to nutrient requirements and satiety without adding substantial calories. Observational data provide consistent evidence to suggest that a diet rich in vegetables and fruits (more than five servings per day) is associated with ~20% decreased CVD risk [46]. Promotion of fruit and vegetables may be behaviourally easier than restricting calories or fat reduction.

^fPlant protein (soy protein): Intake of 30 g/day (2 servings) has been associated with a 4–5% reduction in LDL-C, 3% increase in HDL, and 10% decrease in triglyceride [47].

^gThe Portfolio diet: This is a vegetarian diet that follows therapeutic lifestyle change guidelines and consists of plant sterols (1.0 g/1000 kcal), soy protein (2.5 g/1000 kcal), viscous fibres (10 g/1000 kcal), and almonds (23 g/1000 kcal). The Portfolio diet has been demonstrated to reduce LDL-C levels by about 29% in hypercholesterolemic subjects (comparable with statin) [35]; however, when implemented in a real-world setting with adherence rates of <50% to the various dietary components, 13% reductions in LDL-C were observed over 6 months [48]. Thus, on the basis of the reported intake of portfolio components, the authors report a 4% LDL-C reduction from viscous fiber, 2% each from nuts and soy, and 5% from plant sterols.

^hMediterranean dietary pattern: This is characterized by the daily consumption of fruits, vegetables, whole grain breads, nonrefined cereals, olive oil (the primary source of added fat), and dairy products; moderate weekly consumption of fish, poultry, nuts, potatoes, and eggs; low monthly consumption of red meat; and daily moderate wine consumption. Studies conducted primarily in Mediterranean countries (limited studies have been implemented using this whole diet approach in North America) have shown that compared with a low fat diet, a Mediterranean dietary pattern can promote reductions in BMI (–0.6 kg/m²), systolic and diastolic blood pressure (–1.7/ –1.5 mm Hg), and total cholesterol (–0.19 mmol/L) [32].

ⁱAlcohol: Moderate alcohol intake (30 g/day) can result in increases in HDL-C (~8% increase) [49], but may also increase triglycerides in some people. For those who chose to drink alcohol, Canada's Low-Risk Alcohol Drinking Guidelines apply (<http://www.ccsa.ca/Eng/Priorities/Alcohol/Canada-Low-Risk-Alcohol-Drinking-Guidelines/Pages/default.aspx>).

^jSodium: Reduce sodium to <2300 mg/day to lower blood pressure in individuals with hypertension [50]. A trial of salt reduction will likely be beneficial in most individuals with MetS given that average Canadians eat about 3400 mg of sodium daily [51].

^kDASH eating plan: This consists of a diet rich in fruit (4–5 servings/day); vegetables (4–5 servings/day); whole grains (6–8 servings/day grains; whole grains recommended for most servings); low-fat dairy (2–3 servings/day); lean meat, poultry, and fish (2 servings/day); unsaturated fats and oils (2–3 servings/day); nuts, seeds, and dried beans (4–5 times/week); limited sweets (≤5 /week); an emphasis on dietary and soluble fibre (aiming for a total dietary fibre intake of ~30 grams/day); and a diet rich in potassium, calcium, and magnesium. The reduced sodium (<2300 mg/day) DASH diet can lower systolic blood pressure by 11.5 mm Hg in individuals with hypertension [32].

discussion goes from considering overall lifestyle change to considering specifics of daily behaviour changes [19]. Intention can be assessed many ways, including simple questions like, "What do you think can be done or needs to be done to change xxx?" Possible counselling actions based on SOC are described in Table 2.

Assess and address potential facilitators and barriers to lifestyle change: Assessment of barriers is an important step to consider [16, 20]. Specific barriers can be assessed by direct enquiry or by impression during the interview. Barriers likely to impact dietary behaviour change are shown in Figure 1. By identifying barriers, the RD can engage in problem solving with clients and potentially improve the client's chances of achieving desired changes.

2. Joint Goal Setting

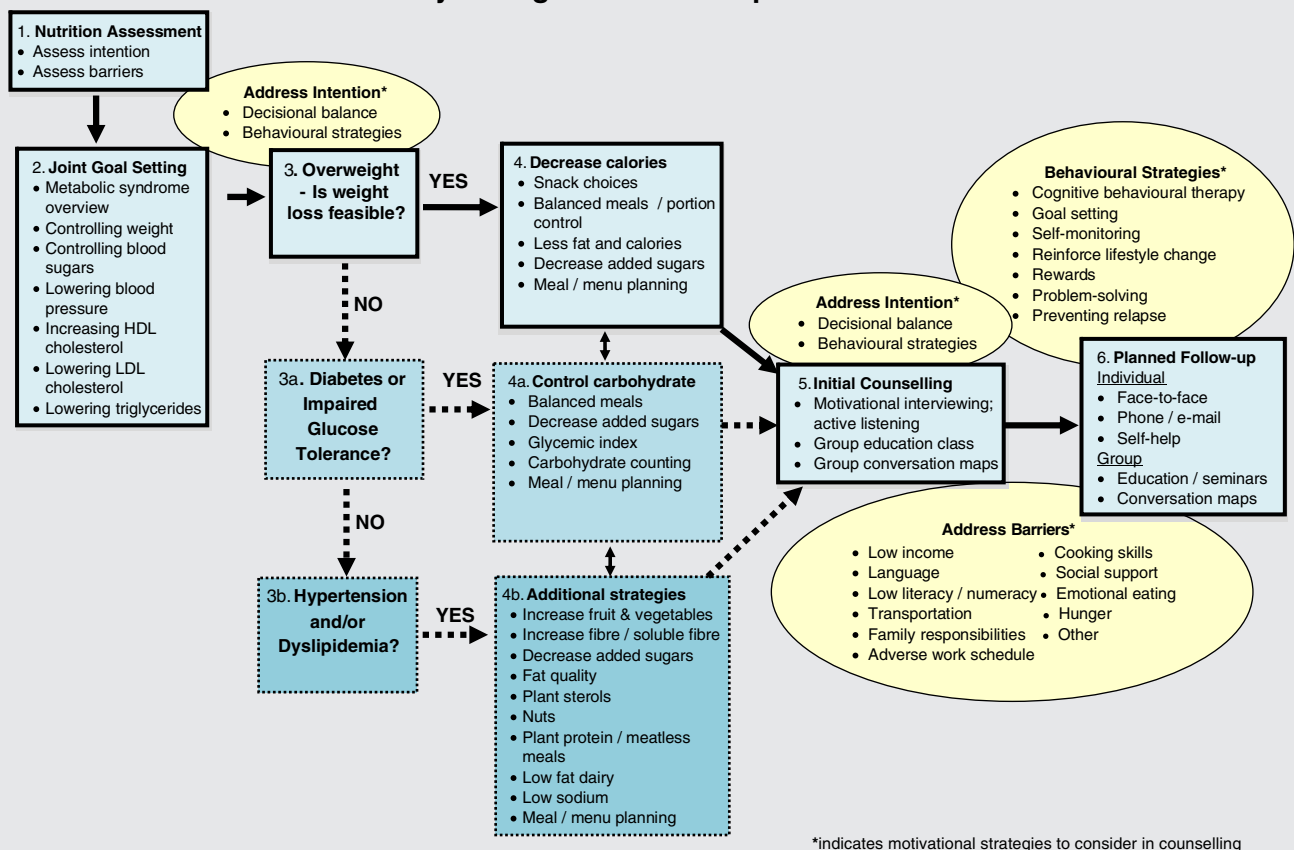
Goal setting for specific diet behaviours is a negotiated process [21]. Joint goal setting considers the client's priorities,

motivations, current dietary and lifestyle behaviours, and areas of concern. We developed a resource to assist with joint goal setting that describes MetS and helps to identify key risk factors [22]. The RD can discuss and prioritize risk factors based on clinical recommendations and client preferences/beliefs. Goal setting is a 2-step process: first to identify the specific MetS risk factor(s) to be addressed and then to review possible diet strategies to address that risk factor. A joint goal setting worksheet may be helpful to identify goals and indicate what the RD and other support people can do to help achieve these goals. Additional practical and visually appealing counselling resources were also developed (i.e., controlling weight, controlling blood sugar, lowering blood pressure, increasing HDL-cholesterol, lowering LDL-cholesterol, and Lowering triglycerides) to facilitate discussion during these conversations. These are available in Dietitians of Canada's PEN online service [22].

Figure 1

Dietary management care map for metabolic syndrome

Dietary Management Care Map - Dietitian's Quick Reference Guide



Developed on behalf of the CHANGE Project - Contact Paula Brauer, PhD, RD pbrauer@uoguelph.ca

Table 2

Possible actions for individuals based on stages of change (adapted from: Dietitians of Canada Diabetes, Obesity, and Cardiovascular Network [36])

Stage of change	Notes/possible actions
Precontemplation: not ready to make a change Contemplation: just beginning to think about change	<ul style="list-style-type: none"> • Individuals who choose not to engage in healthy behaviours even with knowledge that these behaviours would help improve health • May need to be cued to think about the consequences of their behaviour, e.g., <ul style="list-style-type: none"> ◦ pamphlets ◦ talking about pros and cons of change (decisional balance) ◦ completing self-monitoring exercise
Preparation: getting ready to make a change, engaging in planning and commitment Action: making the change, implementing the plan, taking action	<ul style="list-style-type: none"> • Individuals who have successfully managed to change a problem behaviour or who are ready to engage in a healthier behaviour (i.e., seeing the dietitian) • Require goal- or action-oriented intervention setting, e.g., <ul style="list-style-type: none"> ◦ SMART goal setting ◦ action planning and problem-solving ◦ stimulus control and cues
Maintenance: sustaining behaviour change until it is incorporated into lifestyle, maintaining, integrating Relapse: at times slipping back to previous behaviour	<ul style="list-style-type: none"> • Individuals who continue to engage in healthy behaviours for 6 months or more may require a “check-up” or request guidance on problem-solving situations • Sometimes includes brief relapse when unable to navigate situations that trigger unhealthy lifestyle habits

3. Overweight, is weight loss feasible?

Modest weight loss (mean <5%) has been shown to achieve clinically relevant changes in multiple MetS features in some people and is therefore considered first [5]. Calorie reduction or weight loss may not be desired or feasible in some individuals, particularly if barriers are present that can hamper lifestyle change or if the person has a history of weight cycling or disordered eating [23]. The potential for long term harms such as osteoporosis, disordered eating, and weight gain should also be considered [24–26].

Dietitians must use their judgment in determining if weight loss is desirable and/or feasible. Stubbs et al. [27] reported that there are few strong pretreatment predictors of weight loss. A few factors consistently predict successful weight loss (i.e., self-esteem, motivation, program participation), but previous weight loss attempts or previous weight cycling may or may not predict poor success at weight loss.

Many clients in dietetic practice also have unrealistic weight loss goals when starting treatment [28]. Because obesity is a chronic, relapsing condition that requires long-term management, it may be useful to incorporate the “5As” key messages developed by the Canadian Obesity Network into the discussion (www.obesitynetwork.ca/5As). It is important to consider the many individual factors that may affect successful weight loss, as considered by Sharma [29], and to tailor the approach accordingly.

If calorie reduction is not desirable or feasible, weight gain prevention may be a goal, and changes in MetS markers can still

be achieved by focusing on other goals (sections 3a and 3b) and changing the types of foods in the diet (sections 4a and 4b). The two-way arrows shown between the dietary strategies in the care map (Figure 1) reflect the movement that can occur according to changes in clinical markers and client goals over time.

3a. Diabetes or impaired glucose tolerance (IGT): If weight loss is not desirable or feasible, the next step in the care map is assessing the presence of diabetes, prediabetes, or IGT. Control of CHO intake is a core feature of diabetes diet counselling to lower hemoglobin A1c levels and modestly improve the lipoprotein profile and blood pressure [10].

3b. Hypertension and/or dyslipidemia: If blood glucose control is not a primary focus, dietary changes can affect the dyslipidemia and hypertension often seen with MetS. The most common lipid abnormalities associated with MetS are elevated triglyceride levels and low HDL-C levels [2]. Serum LDL-C levels are usually either normal or mildly elevated in individuals with MetS, whereas plasma apolipoprotein B concentration and the number of small dense LDL particles are often increased. If elevated, LDL-C is still the main target of therapy for individuals with dyslipidemia [9]. Once a major focus has been decided, there are a large number of diet changes to be considered, as outlined in the next series of boxes.

4. Decrease calories (if weight loss is feasible)

The methods and tools to decrease caloric intake include promoting meal/snack regularity along with balanced meals and

portion control; these are basic concepts that may be beneficial in promoting calorie reduction and can be introduced early in the counselling process. After mastery of these dietary patterns, more specific instructions may be given including decreasing intake of fat and decreasing intake of added sugars, which may incorporate the concept of volumetrics (i.e., consuming foods which increase satiety yet are lower in calories) [30], and ways to decrease caloric intake while eating out.

4a. Control CHO (if weight loss not feasible, but diabetes or IGT present): The method and tools to control CHO begin with teaching meal regularity and balance (including consistent distribution of CHO) [10]. After mastery of these dietary patterns, instruction on the quality of CHO is often undertaken. Finally, CHO counting may be introduced to those clients who are motivated, ready, and have advanced numeracy and recording skills.

4b. Additional dietary strategies (if weight loss not feasible but hypertension and/or dyslipidemia present): Most strategies have not been specifically studied in individuals with MetS, but rather in groups with mixed CVD risk factors (as described in Table 1). Diet interventions should be tailored to the individual and their presentation of MetS, and consider the client's goals. When groups of dietary interventions are clustered together, they may represent a desirable dietary pattern as seen in the Mediterranean diet [31], the DASH diet [32], and the Portfolio diet [33].

5. Initial counselling

Initial counselling usually starts with individual counselling, but it can include group education/counselling followed by individual counselling. The key features and intensity of efficient and effective counselling remain controversial, but more intensive approaches with an individual component are generally more effective [34].

Behavioural strategies: Dietitians use education and skill building combined with behavioural strategies to achieve lifestyle behavioural change. Multiple strategies to promote change were recently catalogued by Michie et al. [20] in their review of diet and physical activity interventions in which 40 categories of behaviour change techniques were identified. Common techniques are based on TTM [18], motivational interviewing [35], and cognitive behavioural therapy [17]. The overall goal of counselling is to work with patients to cognitively promote positive behaviour changes, which will become new food habits over time. A number of diet counselling guidance tools have been developed to address behaviour change therapy [e.g., 36, 37].

6. Planned follow-up

In the demonstration project, active intervention takes place over the first 3 months, with monthly follow-up to 12 months. It will be customized to each client's needs. It is expected that follow-up over several months is needed to help clients try new approaches and skills, adjust food habits, and assess changes in clinical markers.

RELEVANCE TO PRACTICE

A Dietary Care Map for Management of MetS is a first attempt to describe the steps and decision points RDs consider in managing MetS. The Care Map incorporates a number of potential dietary strategies, which when combined with behavioural counselling can help to achieve positive dietary behaviour change and ameliorate MetS abnormalities. Although several complete packages of diets have been used (e.g., DPP, DASH), currently few diet counselling studies exist that directly compare more than two sets of behavioural strategies. Such studies are needed to refine the features of the care map. In the meantime, the care map and a companion resource list has been developed that identifies some "best available" resources to support specific dietary strategies. These resources are available upon request from the corresponding author.

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References

1. Alberti KG, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation* 2009;120:1640–5. PMID: 19805654. doi: 10.1161/CIRCULATIONAHA.109.192644.
2. Cardiometabolic Risk Working Group: Executive Committee, Leiter LA, Fitchett DH, Gilbert RE, Gupta M, Mancini GB, et al. Cardiometabolic risk in Canada: a detailed analysis and position paper by the Cardiometabolic Risk Working Group. *Can J Cardiol*. 2011;27(2):e1–e33. doi: 10.1016/j.cjca.2010.12.054.
3. D'Agostino RBS, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. *Circulation*. 2008;117:743–53. doi: 10.1161/CIRCULATIONAHA.107.699579.
4. Riediger ND, Clara I. Prevalence of metabolic syndrome in the Canadian adult population. *CMAJ*. 2011 Oct 18;183(15):E1127–34. PMID: 21911558. doi: 10.1503/cmaj.110070.
5. Yamaoka K, Tango T. Effects of lifestyle modification on metabolic syndrome: a systematic review and meta-analysis. *BMC Med*. 2012;10:138. PMID: 23151238. doi: 10.1186/1741-7015-10-138.
6. Estruch R, Ros E, Martínez-González MA. Mediterranean diet for primary prevention of cardiovascular disease. *N Engl J Med*. 2013;369:672. PMID: 23944307. doi: 10.1056/NEJMc1306659.
7. Simmons RK, Echouffo-Tcheugui JB, Sharp SJ, Sargeant LA, Williams KM, Prevost AT, et al. Screening for type 2 diabetes and population mortality over 10 years (ADDITION-Cambridge): a cluster-randomised controlled trial. *Lancet* 2012;380:1741–8. doi: 10.1016/S0140-6736(12)61422-6.
8. Canadian Hypertension Education Program (CHEP), Daskalopoulou SS, Khan NA, Quinn RR, Ruzicka M, McKay DW, Hackam DG, et al. The 2012 Canadian hypertension education program recommendations for the management of hypertension: blood pressure measurement, diagnosis, assessment of risk, and therapy. *Can J Cardiol*. 2012 May;28(3):270–87. doi: 10.1016/j.cjca.2012.02.018.
9. Anderson TJ, Grégoire J, Hegele RA, Couture P, Mancini GB, McPherson R, et al. 2012 update of the Canadian Cardiovascular Society guidelines for the diagnosis and treatment of dyslipidemia for the prevention of

- cardiovascular disease in the adult. *Can J Cardiol*. 2013 Feb;29(2):151–67. PMID: 23351925. doi: 10.1016/j.cjca.2012.11.032.
10. Canadian Diabetes Association Clinical Practice Guidelines Committees. The Canadian Diabetes Association 2013 Clinical practice guidelines for the prevention and management of diabetes in Canada. *Can J Diabetes*. 2013;37(Suppl1):S1–S212. PMID: 24070926.
 11. Lau DC, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children [summary]. *CMAJ* 2007;176: S1–13. PMID: 17420481. doi: 10.1503/cmaj.070306.
 12. Academy of Nutrition and Dietetics (formerly American Dietetic Association). Evidence-based nutrition practice guidelines - nutrition guidelines list [cited 2014 Jan 15]. Available from: <http://andevidencelibrary.com/category.cfm?cid=14&cat=0&auth=1>.
 13. Brauer PM, Hanning RM, Arocha JF, Royall D, Grant A, Dietrich L, et al. Development of a nutrition counselling care map for dyslipidemia. *Can J Diet Pract Res*. 2007 Winter;68(4):183–92. PMID: 18073000. doi: 10.3148/68.4.2007.183.
 14. Mozaffarian D, Appel LJ, Van Horn L. Components of a cardioprotective diet: new insights. *Circulation*. 2011 Jun 21;123(24):2870–91. PMID: 21690503. doi: 10.1161/CIRCULATIONAHA.110.968735.
 15. Nielsen J. Heuristic evaluation. In: Nielsen J, Mack RL, eds. Usability inspection methods. New York, NY: John Wiley & Sons; 1994.
 16. Green LW. What can we generalize from research on patient education and clinical health promotion to physician counseling on diet? *Eur J Clin Nutr*. 1999 May;53 Suppl 2:S9–18. PMID: 10406430. doi: 10.1038/sj.ejcn.1600795.
 17. Vallis M. 5. Assessment of readiness to change. In: Lau DC, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. *CMAJ* 2007;176:S33–35.
 18. Prochaska JO, DiClemente CC. Stages of change in the modification of problem behaviors. *Prog Behav Modif*. 1992;28:183–218. PMID: 1620663.
 19. Wilson GT, Schlamm TR. The transtheoretical model and motivational interviewing in the treatment of eating and weight disorders. *Clin Psychol Rev*. 2004;24:361–78. PMID: 15245836. doi: 10.1016/j.cpr.2004.03.003.
 20. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALORE taxonomy. *Psychol Health* 2011;26:1479–98. PMID: 21678185.
 21. Pearson ES. Goal setting as a health behavior change strategy in overweight and obese adults: a systematic literature review examining intervention components. *Patient Educ Couns*. 2012 Apr;87(1):32–42. PMID: 21852063. doi: 10.1016/j.pec.2011.07.018.
 22. Brauer B, Royall D, Chouinard L, O'Young O. Dietary management of metabolic syndrome: resources for medical nutrition therapy by registered dietitians - fact sheets (December, 2013). In: Practice-based Evidence in Nutrition [PEN] [cited 2014 Jan 15]. Available from: <http://www.pennutrition.com/KnowledgePathway.aspx?kpid=3015&trid=21283&trcatid=9>. Access only by subscription.
 23. Chaput JP, Doucet E, Tremblay A. Obesity: a disease or a biological adaptation? An update. *Obes Rev*. 2012 Aug;13(8):681–91. PMID: 22417138. doi: 10.1111/j.1467-789X.2012.00992.x.
 24. Leblanc ES, O'Connor E, Whitlock EP, Patnode CD, Kapka T. Effectiveness of primary care-relevant treatments for obesity in adults: a systematic evidence review for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2011 Oct 4;155(7):434–47. PMID: 21969342. doi: 10.7326/0003-4819-155-7-201110040-00006.
 25. Cameron J, Goldfield GS, Cy M-J, Doucet É. The effects of prolonged caloric restriction leading to weight loss on food hedonics and reinforcement. *Physio Behav*. 2008;94:474–80. PMID: 18420235. doi: 10.1016/j.physbeh.2008.02.014.
 26. Sumithran P, Proietto J. The defence of body weight: a physiological basis for weight regain after weight loss. *Clin Sci (Lond)*. 2013;124(4):231–41. PMID: 23126426. doi: 10.1042/CS20120223.
 27. Stubbs J, Whybrow S, Teixeira P, Blundell J, Lawton C, Westenhoefer J, et al. Problems in identifying predictors and correlates of weight loss and maintenance: implications for weight control therapies based on behaviour change. *Obes Rev*. 2011 Sep;12(9):688–708. PMID: 21535362.
 28. Wamsteker EW, Geenen R, Zelissen PM, van Furth EF, Iestra J. Unrealistic weight-loss goals among obese patients are associated with age and causal attributions. *J Am Diet Assoc*. 2009 Nov;109(11):1903–8. PMID: 19857632. doi: 10.1016/j.jada.2009.08.012.
 29. Sharma AM. M, M, M & M: a mnemonic for assessing obesity. *Obes Rev*. 2010 Nov;11(11):808–9. PMID: 21182728. doi: 10.1111/j.1467-789X.2010.00766.x.
 30. Lapointe A, Provencher V, Weisnagel SJ, Bégin C, Blanchet R, Dufour-Bouchard AA, et al. Dietary intervention promoting high intakes of fruits and vegetables: short-term effects on eating behaviors in overweight-obese postmenopausal women. *Eat Behav*. 2010 Dec;11(4):305–8. PMID: 20850069. doi: 10.1016/j.eatbeh.2010.08.005.
 31. Tuttle KR, Shuler LA, Packard DP, Milton JE, Daratha KB, Bibus DM, et al. Comparison of low-fat versus Mediterranean-style dietary intervention after first myocardial infarction (from The Heart Institute of Spokane Diet Intervention and Evaluation Trial). *Am J Cardiol*. 2008 Jun 1; 101(11):1523–30. PMID: 18489927. doi: 10.1016/j.amjcard.2008.01.038.
 32. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, et al. DASH-Sodium Collaborative Research Group. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med*. 2001 Jan 4;344(1):3–10. PMID: 11136953. doi: 10.1056/NEJM200101043440101.
 33. Jenkins DJ, Kendall CW, Marchie A, Faulkner DA, Wong JM, et al. Direct comparison of a dietary portfolio of cholesterol-lowering foods with a statin in hypercholesterolemic participants. *Am J Clin Nutr*. 2005 Feb; 81(2):380–7. PMID: 15699225.
 34. Moyer VA. U.S. Preventive Services Task Force. Behavioral counseling interventions to promote a healthful diet and physical activity for cardiovascular disease prevention in adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2012 Sep 4;157(5):367–71. PMID: 22733153.
 35. Miller WR, Rollnick S. Motivational interviewing. 2nd ed. New York: Guilford Press; 2002.
 36. Dietitians of Canada Diabetes, Obesity and Cardiovascular Network. Instigating and implementing eating and physical activity behaviour change: a lifestyle intervention manual & toolkit. 2nd ed; 2012.
 37. Dietitians of Canada. Counselling Strategies Knowledge Pathway. In: Practice-based Evidence in Nutrition [PEN]; 2012 [cited 2013 Oct 16]. Available from: <http://www.pennutrition.com>. Access only by subscription.
 38. Yu-Poth S, Zhao G, Etherton T, Naglak M, Jonnalagadda S, Kris-Etherton PM. Effects of the National Cholesterol Education Program's Step I and Step II dietary intervention programs on cardiovascular disease risk factors: a meta-analysis. *Am J Clin Nutr*. 1999 Apr;69(4):632–46. PMID: 10197564.
 39. Siri-Tarino PW, Sun Q, Hu FB, Krauss RM. Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. *Am J Clin Nutr*. 2010 Mar;91(3):535–46. PMID: 20071648. doi: 10.3945/ajcn.2009.27725.
 40. Hooper L, Summerbell CD, Thompson R, Sills D, Roberts FG, Moore HJ, et al. Reduced or modified dietary fat for preventing cardiovascular disease. *Cochrane Database Syst Rev*. 2012 May 16;5:CD002137. PMID: 22592684.
 41. Balk EM, Lichtenstein AH, Chung M, Kupelnick B, Chew P, Lau J. Effects of omega-3 fatty acids on serum markers of cardiovascular disease risk: a systematic review. *Atherosclerosis*. 2006 Nov;189(1):19–30. PMID: 16530201. doi: 10.1016/j.atherosclerosis.2006.02.012.
 42. Sabaté J, Oda K, Ros E. Nut consumption and blood lipid levels: a pooled analysis of 25 intervention trials. *Arch Intern Med*. 2010 May 10; 170(9):821–7. PMID: 20458092. doi: 10.1001/archinternmed.2010.79.

43. Wei ZH, Wang H, Chen XY, Wang BS, Rong ZX, Wang BS, et al. Time- and dose-dependent effect of psyllium on serum lipids in mild-to-moderate hypercholesterolemia: a meta-analysis of controlled clinical trials. *Eur J Clin Nutr.* 2009 Jul;63(7):821–7. PMID: 18985059. doi: 10.1038/ejcn.2008.49.
44. Talati R, Baker WL, Pabilonia MS, White CM, Coleman CI. The effects of barley-derived soluble fiber on serum lipids. *Ann Fam Med.* 2009 Mar-Apr;7(2):157–63. PMID: 19273871. doi: 10.1370/afm.917.
45. Demonty I, Ras RT, van der Knaap HC, Duchateau GS, Meijer L, Zock PL, et al. Continuous dose-response relationship of the LDL-cholesterol-lowering effect of phytosterol intake. *J Nutr.* 2009 Feb;139(2):271–84. PMID: 19091798. doi: 10.3945/jn.108.095125.
46. Mente A, de Koning L, Shannon HS, Anand SS. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. *Arch Intern Med.* 2009 Apr 13;169(7):659–69. PMID: 19364995. doi: 10.1001/archinternmed.2009.38.
47. Anderson JW, Bush HM. Soy protein effects on serum lipoproteins: a quality assessment and meta-analysis of randomized, controlled studies. *J Am Coll Nutr.* 2011 Apr;30(2):79–91. PMID: 21730216. doi: 10.1080/07315724.2011.10719947.
48. Jenkins DJ, Jones PJ, Lamarche B, Kendall CW, Faulkner D, Cermakova L, et al. Effect of a dietary portfolio of cholesterol-lowering foods given at 2 levels of intensity of dietary advice on serum lipids in hyperlipidemia: a randomized controlled trial. *JAMA.* 2011 Aug 24;306(8):831–9. PMID: 21862744. doi: 10.1001/jama.2011.1202.
49. Brien SE, Ronksley PE, Turner BJ, Mukamal KJ, Ghali WA. Effect of alcohol consumption on biological markers associated with risk of coronary heart disease: systematic review and meta-analysis of interventional studies. *BMJ.* 2011 Feb 22;342:d636. PMID: 21343206. doi: 10.1136/bmj.d636.
50. Graudal NA, Hubeck-Graudal T, Jurgens G. Effects of low sodium diet versus high sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride. *Cochrane Database Syst Rev.* 2011 Nov 9;(11):CD004022. PMID: 22071811.
51. Health Canada. Canadian Community Health Survey, Cycle 2.2, Nutrition (2004). A Guide to Accessing and Interpreting the Data; 2006. Available from: http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/surveill/cchs-guide-esc-cc-eng.pdf.