

Position of the American Dietetic Association: Integration of Medical Nutrition Therapy and Pharmacotherapy

ABSTRACT

It is the position of the American Dietetic Association that medical nutrition therapy (MNT), as a part of the Nutrition Care Process, should be the initial step and an integral component of medical treatment for management of specific disease states and conditions. If optimal control cannot be achieved with MNT alone and concurrent pharmacotherapy is required, the Association promotes a team approach and encourages active collaboration among registered dietitians (RDs) and other health care team members. RDs use MNT as a cost-effective means to achieve significant health benefits by preventing or altering the course of diabetes, obesity, hypertension, disorders of lipid metabolism, heart failure, osteoporosis, celiac disease, and chronic kidney disease, among other diseases. Should pharmacotherapy be needed to control these diseases, a team approach in which an RD brings expertise in food and nutrition and a pharmacist brings expertise in medications is essential. RDs and pharmacists share the goals of maintaining food and nutrient intake, nutritional status, and medication effectiveness while avoiding adverse food–medication interactions. RDs manipulate food and nutrient intake in medication regimens based on clinical significance of the interaction, medication dosage and duration, and recognition of potential adverse effects related to pharmacotherapy. RDs who provide MNT using enhanced patient education skills and pharmacotherapy knowledge are crit-

ical for successful outcomes and patient safety.

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POSITION STATEMENT

It is the position of the American Dietetic Association that medical nutrition therapy, as a part of the Nutrition Care Process, be the initial step and an integral component of medical treatment for management of specific disease states and conditions. If optimal control cannot be achieved with medical nutrition therapy alone and concurrent pharmacotherapy is required, the Association promotes a team approach and encourages active collaboration among registered dietitians and other health care team members.

Medical nutrition therapy (MNT), an intervention within the Nutrition Care Process and Model, was defined in 2001 federal legislation as “nutritional diagnostic, therapy, and counseling services for the purpose of disease management, which are furnished by a registered dietitian or a nutrition professional” (1,2). MNT is part of an individualized plan designed to treat a nutrition diagnosis that is derived from the findings of an in-depth nutrition assessment. Since all individuals must ingest foods and nutrients to survive, modifications to intake are among the least expensive and safest means to prevent and treat disease. Registered dietitians (RDs) use nutrition intervention and counseling to significantly improve weight, body mass index, hemoglobin A1c, blood pressure, and serum lipid levels (3). RDs also use MNT to achieve significant health benefits by preventing or altering the course of diabetes, obesity, hypertension, disorders of lipid metabolism, heart failure, osteoporosis, celiac dis-

ease, and chronic kidney disease, among others (3). Physicians and other licensed independent practitioners use MNT provided by RDs in combination with pharmacotherapy—the treatment of disease using medications provided by pharmacists—as part of a comprehensive approach to disease state management.

ROLE OF RDs IN MANAGEMENT OF MNT FOR PATIENTS RECEIVING PHARMACOTHERAPY

As MNT providers, RDs advocate for, organize, and implement MNT for individuals who will benefit from modifications in food and nutrient intake. The RD develops a nutrition prescription for MNT based on individualized energy, macronutrient, vitamin, mineral, and fluid requirements and the influence of medications. The RD intervenes with foods, supplemental nutrients, enteral nutrition, parenteral nutrition, and basic lifestyle and exercise modification. RDs use expert knowledge of food composition and nutrient metabolism to individualize intake, working with food preferences and lifestyle habits to improve adherence, and achieve synergies between medication and nutritional treatments. RDs collaborate with individuals and available family members, pharmacists, physicians, and others to ensure that the plan for nutrition intervention is carried out in coordinated fashion and to minimize the side effects of many medications. RDs also delegate portions of MNT interventions as resources are available (4).

The role of MNT changes according to individual need. An RD may implement MNT to prevent diseases or nutrient medication interactions (5). For certain diseases, an RD may implement nutrition intervention to prevent secondary complications. For other diseases, MNT is the sole ther-

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apy (6). As medications are prescribed for disease, MNT should continue to achieve a synergistic effect. Patients taking medications for long periods of time may require re-education as new information about medications is released (7). Modifications to MNT may be needed during acute illness when diet restrictions and medication regimens may be adjusted to encourage intake. The need for MNT may also change near the end of life as food and nutrition restrictions are lifted.

Management of Pharmacotherapy by Pharmacists

Use of pharmacotherapy has expanded as the number of medications on the market has increased. Pharmacists are experts on medications and are responsible for sharing information on potential medication/nutrient interactions and educating individuals about how to safely and effectively take medications. In many settings, a pharmacist manipulates medication dosages to optimize therapeutic effect or to avoid untoward effects (8). Such education is most effective when an RD's expertise in foods has been combined with a pharmacist's expertise in medications.

Benefits of the Team Approach

As knowledge of the synergistic relationship between MNT and pharmacotherapy increases, it is clear that RDs must establish collaborative relationships with not only those being treated, but also with pharmacists and physicians to optimize care plans. A collaborative, interdisciplinary approach facilitates more comprehensive care and is recommended to improve health care quality and safety (9). A collaborative team approach is also encouraged in accreditation standards for health care organizations. Not all organizations and individuals have access to RDs and pharmacists because providers are unavailable or there is insufficient reimbursement for MNT and pharmacotherapy services.

BASIC PHARMACOTHERAPY KNOWLEDGE IN MNT PLANS

To design the nutrient portion of MNT and pharmacology, certain principles about medications and nutri-

ents need to be understood. Medications and food are similar in some ways and vastly different in others. Medications, with the exception of herbs and botanicals, are manufactured according to very controlled standards for levels of active ingredients. Foods, on the other hand, vary widely in their specific composition depending upon their variety, environmental and growing conditions, and processing methods. Most food and medications are taken orally and must be absorbed in the gastrointestinal tract before going to the liver before being carried by the cardiovascular system to the targeted area(s). This is possible because absorbable medications share some chemical features with nutrients, but differ enough not to be digested (10). The body does not have separate pathways for food and medications; they share the same systems and may well compete for carriers, enzymes, substrates, and energy (11). The important pharmacokinetic areas are absorption (sublingual, stomach, intestine), distribution (fluid, adipose tissue, muscle), metabolism (increase solubility, conjugation), and elimination (passive or active) (10). Factors influencing medication elimination may increase the likelihood for medication-medication interactions.

Prescription and Nonprescription Medications, Herbs, and Botanicals: Basic Metabolic Targets and Pathways

Self medication with nonprescription medications or over-the-counter medications has grown enormously as health costs rise and access to health insurance has fallen (12). Self-medication may also take the form of alcohol, which has been described as the most pervasively used and abused medication in the world (13). Herbs, botanicals, and dietary supplements have been described as falling between a food and a medication (14). Because these are largely plant-derived, natural variation in active ingredients occurs. A new Dietary Supplements Ingredient Database was recently released through the joint efforts of the US Department of Agriculture's Agricultural Research Service and the National Institutes of Health Office of Dietary Supplements (15). The major actions of foods on medications appear to be on proteins

that determine absorption, distribution, and elimination. Polyphenols (eg, anthocyanins, flavinoids, tannins) are a class that contains some potent inhibitors or inducers of cytochrome P450 enzymes that are highly involved in medication metabolism, especially when concentrated by extraction or taken for a long time (14).

Individual Differences in Medication Responses

Although individual differences in response to medications have long been recognized, the reasons for these differences are just beginning to be understood. Chronic disease may result from more than one molecular pathway defect, the multiple pathway possibilities may obscure gene-disease or gene-nutrient phenotype analyses, and the physiological response to disease presence may alter genetic expression (16,17). Given these different pathways, response to medications may vary (18,19). MNT may be modified as individual differences in disease causes, medication efficacy, and nutritional status/needs become identified and more essential in best practices (19). For example, the coumarins, a mainstay of oral anticoagulant therapy for more than 50 years, exhibit considerable variability in dose responses among individuals and are subject to interactions with other medications and diet (20).

Age appears to play an important role in the risk of frequent and severe food-medication interactions. Lowered glomerular filtration rates with advancing age may mean greater risk when medications are not excreted as rapidly as in young adults. For example, grapefruit juice may induce a toxic reaction in older individuals taking antihistamines (21). Body composition changes with age, typically with a loss of total body protein, occur largely due to loss of lean muscle mass and increased adipose tissue. These changes alter the body's responses to medications that target these tissues (22). Varying levels of physical activity may induce changes in the body's response to medication and nutrient metabolism (10).

Nutritional status has a profound effect on the body's response to all therapy, including pharmacotherapy and MNT. Short-term (3 months) of poor dietary intake may lead to sub-

clinical levels, especially B vitamin levels. Low thiamin intake influences appetite and leads to even poorer nutritional status. Inadequate dietary intake of thiamin has been associated with use of diuretics (23). More recently, the question has been raised as to whether individuals with diabetes may need therapeutic levels of thiamin to normalize red cell thiamin status (24). Anemia in chronic heart failure has been related to fluid retention as well as impaired renal perfusion and blunted erythropoietin production (25).

All of these factors may increase or decrease the response to the area under the curve that determines the half-life and effective dosages of a medication (10).

Priorities for Monitoring Food Intake in Medication Regimens

Priorities of monitoring food intake in medication regimens need to be evaluated carefully and based on scientific evidence as food can interfere with medication effectiveness. For example, any number of medications can be affected by the intake of grapefruit and other fruits that act on the cytochrome P450. Cytochrome P450 is a large family of enzymatic proteins that catalyzes the oxidation of substrate molecules, and the plasma concentration–time curve (area under the curve) can be markedly elevated in the presence of some medications and grapefruit (26). The question is not simply whether an interaction could occur, but rather is there a clinically significant interaction. An RD and a pharmacist working as a team can identify those medications likely to cause a clinically significant response warranting elimination of grapefruit or other juices from an individual's diet. Certain foods interfering with some medications are more important than others (eg, interfering with the cyclosporine regimen might lead to loss of a kidney transplant opportunity). Nutrient–medication interactions that can produce a potentially serious illness or death in the short term should be of upper most importance in nutritional counseling (27).

Other nutrient–medication interactions are the loss of potential effectiveness of the medication or medications interfering with nutritional

status. Consistency of food intake may be highly important (eg, warfarin and vitamin K–rich foods). Less critical at onset of counseling but still very important are those medications that interfere with nutritional status with long use (eg, phenytoin, nonsteroidal anti-inflammatory medications) (27). A thorough knowledge of food composition literature relative to the high-risk food medication interactions is essential for good MNT and pharmacotherapy practice (28).

Potential Adverse Effects Related to Pharmacotherapy

Concurrent MNT and pharmacotherapy are critical to success in several regimens, including diabetes, anticoagulation regimens, and monoamine oxidase inhibitors regimens. The latter is important not only in startup of the regimen, but also in discontinuation of monoamine oxidase inhibitors therapy as the risk for hypertensive crisis may remain for 1 to 2 months due to persistent low enzymatic levels (28). Although a lower risk priority, individuals requiring antihypertensive medication and consuming a high dietary intake of salt, for example, may necessitate higher doses of antihypertensive medications and consequently increase the medication cost and the chance of more side effects (28). The risks associated with pharmacological or prolonged use of vitamin and mineral supplements need to be considered (29). For example, high intake of preformed vitamin A, a fat-soluble vitamin, may pose a risk, but use of the pro-vitamin form of the supplement (eg, carotenoids) poses little risk of adverse effects. In general, water-soluble vitamins pose no risk if taken for long periods of time with the exception of high doses of vitamin B-6, which may cause a toxic sensory neuropathy called white glove/sock syndrome (29). The use of vitamins and mineral supplements may lower the effectiveness of some medications (eg, vitamin C and warfarin) (15).

INTEGRATION OF MNT AND PHARMACOTHERAPY IN CHRONIC DISEASE MANAGEMENT OF DIABETES MELLITUS

Approximately 1.6 million new cases of diabetes are diagnosed each year

(30). The incidence of diabetes in the general US population is in excess of 10% of those aged 20 years or older and rises to more than 23% of those aged 60 years or older (30). In comparison with pharmacotherapy or no intervention, MNT is a cost-effective diabetes prevention. For persons with diabetes, RDs may use nutrition interventions for a period of several weeks or months to achieve changes in food and nutrient intake as antidiabetes medications are being adjusted to optimize glucose control. The outcome for successful team intervention, including MNT, for type 2 diabetes includes blood glucose control, improved insulin sensitivity, and reduced risk factors for cardiovascular disease (30). Three to 6 months of MNT can result in 0.25% to 2.9% reductions in hemoglobin A1c, depending on the type and duration of diabetes. Researchers who studied patients receiving 6 to 12 months of MNT report a variety in the number and type of MNT sessions that lead to improved outcomes, sustained improvements in hemoglobin A1c, improved lipid profiles, appropriate weight management, decreased need for medications, and reduced risk for onset and progression of comorbidities (3).

Glycemic Control

Glycemic control, which requires a balance between carbohydrate intake and administration of hypoglycemic agents, is advocated to reduce infection rates (31). Because of their expertise in the carbohydrate composition of foods and fluids, RDs play a key role in designing and implementing glucose control protocols. Although optimum blood glucose levels and carbohydrate intake are unknown, RDs provide a valuable service in manipulating oral, enteral, and parenteral carbohydrate intake in concert with changes in medications to achieve and maintain glycemic control (32).

Gestational Diabetes

Approximately 4% of pregnant women, about 130,000 women annually, develop gestational diabetes, which is associated with an increased risk for type 2 diabetes developing within 10 years (33). MNT and glucose monitoring are implemented ini-

tially and pharmacotherapy is added as needed for glucose control as well as to ensure adequate nutrition for the mother and fetus. A recent analysis of the evidence recommends initiation of MNT within 1 week of identification of impaired glucose tolerance in pregnant women (34,35). If implemented early, MNT results in decreased hospital admissions and insulin use, improves likelihood of normal fetal and placental growth, and reduces risk of perinatal complications (35).

Obesity

MNT is the preferred treatment for obesity because of the side effects of medications and bariatric surgery (36). When provided by an RD, MNT results in both statistically and clinically significant weight loss in otherwise healthy overweight and obese adults. At least four studies show that when provided over a 6-month period, MNT can reduce body weight by 10% and maintain weight loss for more than a year (3). RDs are taking a greater role in adjusting medications to coincide with changes in nutrient intake as well as incorporating over-the-counter obesity medications in the plan for MNT (37,38). Before planning most surgical interventions, clients must demonstrate inability to lose weight with conventional obesity treatment; however, MNT provided by an RD is a prominent component of bariatric surgery programs (37).

Hypertension

Hypertension is often treated with medications, but the effectiveness of nutrition interventions is becoming better recognized. In the Dietary Approaches to Stop Hypertension trial, investigators concluded that changes to food and nutrient intake could lower systolic blood pressure (SBP) by 8 to 14 mm Hg whereas 30 minutes of physical activity most days could lower SBP by 4 to 9 mm Hg. Maintaining a sodium intake of 2,300 mg could lower SBP by 2 to 8 mm Hg, whereas restricting daily sodium intake to 1,600 mg may yield results similar to single medication therapy in some individuals. Regardless of the dietary sodium level, however, the Dietary Approaches to Stop Hypertension and Premier clinical trials dem-

onstrated the beneficial effects of high vegetable, fruit, and low-fat dairy foods, most likely due to the improved mineral intakes (eg, magnesium and potassium) (39). Another dietary approach, resulting in a weight reduction of 22 lb was also effective in reducing SBP by 5 to 20 mm Hg for individuals with a body mass index >24.9 (39). Clients treated with anti-hypertensive medications may also benefit from individualized advice on potassium consumption because increased or decreased potassium requirements may result from these medications.

Disorders of Lipid Metabolism

MNT is the cost-effective cornerstone of prevention and treatment of hypercholesterolemia and other lipid disorders with and without pharmacotherapy (3,40). In mild to moderate hypercholesterolemia, the total costs for RD counseling averaged <\$400 annually compared to nearly \$1,500 for medication. Each dollar spent on MNT was estimated to avert \$3.58 in statin therapy (40). The combination of MNT and medications for treatment of more severe forms of lipid disorders allows lower dosage and subsequently lesser side effects than medications used alone (41).

Heart Failure

Heart failure, a chronic condition that progresses over many years, affects about 5 million Americans and contributes to 300,000 deaths each year. MNT consisting of restricted sodium and fluid intake is an important component of nonpharmacologic therapy that can minimize heart failure side effects including edema (42). Individualized MNT provided by an RD during an initial visit and with follow-up over a 6-week to a 9-month period has been shown effective in reducing sodium and fluid intake and improving quality of life in heart failure patients (43,44).

Patients with heart failure are often treated with angiotensin converting enzyme inhibitors that may result in altered taste sensations and may reduce overall food and nutrient intake. Without MNT, reduced food and nutrient intake will eventually result in undernutrition, which decreases heart failure survival (45). In addition,

patients receiving angiotensin converting enzyme inhibitors, diuretics, and digoxin should be monitored for drug-related changes in serum potassium levels and the need for adjustments to potassium intake.

The anticoagulant warfarin, often prescribed in heart failure, interacts with vitamin K, and MNT is useful in helping patients to maintain a consistent vitamin K intake (45).

Osteoporosis

This disease impacts approximately 10 million people, both men and women. Recommendations from several sources include a total intake of 1,200 mg elemental calcium and 800 to 900 mg vitamin D daily (22,46,47). There is also a growing body of literature suggesting that vitamin K plays a role in prevention of osteoporosis (47). A skilled RD can evaluate the patient's intake and correct an inadequate diet with individualized modifications of food and nutrient intake, including supplemental nutrients as needed.

Celiac Disease

Celiac disease is an autoimmune disorder for which there is no treatment other than a gluten-free diet. Eliminating sources of gluten from food, nutrient, and medication intake requires extensive knowledge of food composition, food processing, and sources of gluten in medications. Implementing a gluten-free diet may require an extended education period (6). No pharmacotherapy that accompanies this MNT exists, and an RD with a physician helps patients control the disease.

Chronic Kidney Disease

Renal disease is often precipitated by hypertension and diabetes, both of which can be improved by MNT as described in the section on hypertension (48). For patients with kidney disease who are not on dialysis, modification of protein intake can delay progression of renal failure and the need for dialysis (49). Changes in the glomerular filtration rate also affect potassium, phosphorus, carbohydrate, and fluid intake, as well as the need for phosphorus binders and insulin (50,51). RDs manipulate food

and nutrient intake and often adjust the phosphorus binders and other nutrition-related medications to optimize nutritional well-being of patients with chronic kidney disease.

OTHER ISSUES

Food, Nutrient, and Medication Interactions

Polypharmacy has been described as the use of multiple medications, generally between six and 12, some of which may not be clinically indicated (52). Polypharmacy is commonly believed to impair appetite, although a cause and effect relationship has not been clearly demonstrated. An RD who identifies polypharmacy may suggest that his or her clients or patients have their medications reviewed by a pharmacist or by their primary care providers to identify opportunities to streamline pharmacotherapy. Short-term use of medications (eg, antibiotics) is unlikely to have great effect on nutritional status, but long-term, chronic use of certain medications (eg, steroids) carries risk for negative influence on nutritional status, especially vitamins, that may go unrecognized without an RD to monitor nutritional status (27).

Medications are known to change energy metabolism with rapid and large (10 to 15 lb) weight gains common in some individuals newly placed on psychotropic medications, for example, which may present an added stressor on emotional health (19). Initial MNT counseling by RDs to prevent or slow weight gain with these medication regimens is preferred over initiating weight loss regimens. Better understanding of the underlying mechanisms can guide useful MNT in modulating food intake in both appetite stimulation and suppression (19). Appetite suppression sufficient to produce weight loss or cachexia is often an indication for orexigenic aids such as dronabinol and megestrol acetate. Because these drugs are ineffective without an adequate and balanced food and nutrient intake, RDs and pharmacotherapists must collaborate to ensure appropriate medication dosing and nutrient intake in these patients (45).

Enteral Feeding and Medication Interactions

Enteral feedings are frequently used but are often administered at suboptimal rates for a variety of reasons (53). However, studies show that patients achieve nutrient intake goals more quickly if an RD manages the feeding schedule, rate, concentration, and feeding composition to ensure adequate intake (54). When patients receive certain medications that interfere with nutrient absorption or clog the feeding tubes, review by an RD is essential to ensure adequate intake of nutrients. RDs must collaborate with pharmacists and nurses to develop a medication and feeding administration schedules that ensure adequate nutrient intake.

Best Practices for MNT and Pharmacotherapy for RDs

- Periodically review the literature, especially topic reviews, meta-analyses, clinical trials, and the American Dietetic Association's Evidence Analysis Library for current pharmacotherapy and MNT information relevant to practice.
- Periodically review food composition databases for updated information that reflects improved or expanded nutrient analysis as well as changes in processing techniques (27).
- Occasionally review current advances in complementary medicine and investigate the science as some clients will still want to use these therapies.

Use of Complementary Therapies with MNT and Pharmacotherapy

The National Center for Complementary and Alternative Medicine defines complementary therapies as a changing list of diverse medical and health care systems, practices, and products that are not presently considered to be part of conventional medicine but are used together with conventional medicine (55). Complementary therapies include acupuncture, Aruyveda, and traditional Chinese medicine, as well as herbals and botanicals, which are also described as nonvitamin–nonmineral natural products. Herbals and botanicals were used in 2007 by just under 18% of the adult popu-

lation and just under 4% of children. For adults, the most popular substances were fish oil and n-3 fatty acids such as docosohexaenoic acid, followed by echinacea, glucosamine, flaxseed oil or pills, and ginseng. Similar items were consumed by children (55). RDs may be practitioners of complementary therapies, or may integrate these therapies into an overall treatment plan. Patients seeking this type of therapy often have food, nutrition, and lifestyle preferences that may benefit from the expertise of an RD to ensure safe food sources and adequate nutrient intake. RDs must remain current with changes and the evidence-based guides to practice, ascertain whether patients are using such complementary therapies, provide current information, and collaborate with patients, pharmacists, physicians, and others to ensure patient safety.

Patient Education Enhancement

RDs may work in a one-on-one, group, or electronic environment, selecting the educational materials and providing necessary diet and lifestyle interventions for individuals who need MNT. RDs may also provide basic pharmacotherapy information. An RD may assign some educational activities and follow-up data collection to dietetic technicians, registered, under his or her supervision. In cases where there are insufficient RDs to conduct all the necessary patient education, routine basic education may be delegated to dietetic technicians, registered, but an RD continues to be responsible for regularly and carefully reviewing all educational materials to ensure they are current and accurate.

Future Technology Applications

RDs are currently using electronic and other communications media to conduct disease state monitoring, including follow-up education, monitoring of interventions, outcomes assessment, and reassessment. Interactive compressed video often termed telemedicine offers another media by which remote consultations between pharmacologists in medical schools and RDs working in isolated practice settings can occur (56). Telemedicine can enhance team teaching by phar-

macy and dietetics professors to provide continuing education and educational sessions to rural hospitals. As technology becomes more available, this trend is anticipated to continue, with MNT becoming available to individuals in more remote locations. Future technology, including electronic health records, is anticipated to generate unprecedented amounts of data that can be used to improve MNT for individuals, and also for groups (57).

CONCLUSIONS

MNT is a growing and changing area of practice. At the same time pharmacotherapy is also expanding. As more is learned about the influence of MNT, it is anticipated that MNT applications will expand and that integration of pharmacotherapy and MNT will continue to be needed. Continuing education in the integration of MNT and pharmacotherapy will be needed as this area of practice evolves. As the providers of MNT services, RDs use MNT to prevent disease and to manage chronic disease by increasing medication effectiveness, maintaining nutrition status, and preventing adverse complications.

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