

FOOD Insight™

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Vitamin D in the Spotlight: An Expanded Role Emerges for Promoting Health



Vitamin D is best known for its key role in forming and maintaining strong bones. Yet research is revealing that vitamin D may play additional roles in a growing list of benefits, and experts around the world are calling for a reassessment of dietary recommendations for vitamin D. Vitamin D is involved in regulating cell growth and differentiation and in essential immune system functions. With this knowledge, scientists are exploring links between low vitamin D status and increased risk for a number of chronic diseases, including some types of cancer, heart disease, type 1 diabetes, rheumatoid arthritis, and multiple sclerosis. It also may be important for the maintenance of physical strength and balance in the elderly. Concurrently, evidence is mounting that higher amounts of vitamin D may be required to

maintain blood levels in a range that maximizes calcium absorption and supports these health benefits. However, many Americans do not consume the recommended amount of vitamin D, and some populations may not get enough from the sun.

Vitamin D Basics and Beyond

The two primary forms of vitamin D are vitamin D3 (cholecalciferol), derived from animal sources and vitamin D2 (ergocalciferol), derived from plant and yeast sources. Vitamin D is found naturally in a limited number of foods in the form of vitamin D3, and select foods are fortified with vitamin D2 or D3. Vitamin D3 can also be produced in skin cells when the body is exposed to sunlight, through conversion of a cholesterol-like molecule that is naturally present in the skin. Regardless of the source, food or sunlight, vitamin D2 or D3 is converted in the liver to its circulating form, 25-hydroxyvitamin D (25(OH)D). While this is not the active form of vitamin D, it is the

form used as the clinical indicator of vitamin D status.

After traveling to the kidney, circulating vitamin D is converted to the active form of vitamin D, 1,25-dihydroxyvitamin D (1,25(OH)2D). This active form helps to maintain the body's level of circulating calcium, which is needed for bone mineralization, metabolic, and neuromuscular functions. Although it was once thought that only the kidney converts vitamin D to its active form, it is now known that many tissues in the body, including the brain, breast, prostate, pancreas, and colon can convert 25(OH)D to active 1,25(OH)2D. Emerging research suggests that this ability plays a role in regulating cell growth, which may have important consequences for reducing the risk of certain health problems.

Vitamin D Deficiency: Causes and Consequences

A number of factors can lead to vitamin D insufficiency and deficiency. These factors include limited vitamin D in the diet, extensive use of sunscreens, dark skin pigmentation, living at a high latitude, and diminished outdoor activity. In a recent analysis of vitamin D intakes

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Space Foods to Functional Foods: Processed Foods Make History

Back in the “good old days,” people kneaded dough for bread and preserved summer fruits and vegetables to eat over the winter. But in the 20th century our world changed rapidly and so did our methods of food preparation. Today the major portion of our family’s food needs comes from processed food products that add variety to our diets and convenience to our busy lives. Processed foods also have a fascinating history that is tied to our culture and to important historical events.

Humans have been processing foods—preserving them for future use and to insure their safety—for centuries. In fact historians trace the origins of food processing back to the ancient Egyptians who knew how to use the fermentation action of yeast to bake bread and brew beer. Our ancestors used salt to preserve meats and fish, preserved fruit with sugar, and pickled cucumbers in a vinegar solution.

Landmarks in Food Processing

Canned foods as we know them today have their origin in the late 1700’s as Napoleon’s troops faced a serious food shortage. The French government offered a substantial prize to anyone who could develop a means of preserving food to keep the army supplied while on the march. Nicholas Appert, a confectioner, theorized that putting fresh foods in airtight containers and heating them, would preserve the foods inside. After years of experimentation he submitted his invention and won the prize in 1809. While Appert may not have understood that his process depended on sterilization to kill bacteria, his canning process is directly responsible for the multitude

of prepared foods on our grocery shelves today.

It was almost 100 years later that Clarence Birdseye, working as a field naturalist in Labrador, noticed how easily food was preserved in the arctic climate, and later developed a commercially viable quick-freezing process. Although the concept of frozen foods was not new, Birdseye said, “Perhaps my basic contribution was the idea that a wide line of perishable foods—meats, poultry, seafood, fruits, and vegetables—could be dressed ready to cook, conveniently packaged, really quick frozen, and then delivered to housewives while still truly fresh.”

Technology Expands Choices

Technological advances accelerated in the 20th century with innovations such as juice concentrates, freeze drying, preservatives, and nonnutritive sweeteners. Space travel and changing lifestyles spurred these and other advances, but know-how alone was not enough to bring about the transformation of our food supply into the rich variety of products found in today’s supermarket. Consumers needed some assurance that new processes and additives resulted in safe foods. Early in the 20th century a group of dedicated government scientists began their pioneering work in food safety and consumer protection. Led by Dr. Harvey Wiley, chief chemist of the Agriculture Department’s Bureau of Chemistry, they set out to test food additives for safety and to determine safe consumption levels.

The new art of chemistry that had produced pasteurization and other beneficial developments also made it possible for some manufacturers

to engage in novel forms of cheating. In the absence of regulations, these manufacturers promoted and sold untested chemicals as food preservatives, added brown food coloring to glucose to produce a cheap but inauthentic “honey,” and engaged in other deceptive and possibly dangerous practices. In 1902 Wiley organized a group of volunteers known as the “Poison Squad,” who tested the effects of chemicals and adulterated foods on themselves. Wiley’s efforts resulted in the 1906 passage of the Pure Food and Drugs Act, prohibiting interstate commerce in misbranded and adulterated foods, drinks, and drugs. Through reorganization and name changes the Bureau of Chemistry evolved into the Food and Drug Administration (FDA), with the major responsibility for our nation’s food and drug regulatory activities.

Congress continued to expand FDA’s regulatory authority with the Federal Food, Drug and Cosmetic Act of 1938. In another landmark development, the 1958 Food Additives Amendment required that manufacturers of new food additives establish their safety before they are allowed in the market. Today’s governmental food safety network encompasses a variety of agencies in addition to FDA, including the Department of Agriculture (meat and poultry products), Environmental Protection Agency (pesticides), Department of Commerce (seafood), Federal Trade Commission (food advertising), and most recently, the Office of Homeland Security (border security and transportation).

Too Much of a Good Thing?

The US food supply is the most varied and abundant in the world.

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Space Foods to Functional Foods

Yet processed foods sometimes are criticized for being “too processed,” a complaint that ignores the many consumer benefits that these products provide.

Numerous studies show that processed foods are as nutritious or in some cases more nutritious than their unprocessed counterparts. Frozen vegetables retain their high vitamin and mineral content because they are processed within hours of harvest. For fresh vegetables, however, the time needed for picking and transporting usually translates into days or weeks before they reach the dinner table, resulting in a gradual loss of nutrients over time.

Food safety is enhanced by processing methods designed to rid foods of harmful bacteria that can cause illness. Heat treatments such as pasteurization rid juice and milk of organisms such as *E. coli* and *Salmonella*. Cooking and other heat treatments also make foods shelf-stable (not needing refrigeration before opening) by destroying organisms that cause spoilage.

Processing can also improve nutrition by making some nutrients more available. For example, cooking and canning tomatoes to make tomato paste or sauce increases the

amount of lycopene that is available to the body.

The basic purpose behind processing food is not only to make it safe to eat at a later date, but also to look, taste, and smell as enticing as possible. Rather than diminishing our diets, processed foods actually facilitate the selection of a balanced diet, as they enable consumers to shop less frequently and to stock a wide range of foods on which to base varied and nutritious meals.

Food Spin-offs from Space

Some of today’s familiar food technologies have their origins in the US space program that began in the early 1960s. The need for astronauts to prepare food easily and safely led to many Earth-bound innovations in food processing. Of particular importance is the development by the National Aeronautics and Space Administration (NASA) of the Hazard Analysis Critical Control Point (HACCP) concept which addressed the need for freedom from potential disease-producing bacteria and toxins. HACCP focuses on preventing food safety problems through a science-based, seven-step system that maintains control over the entire food preparation process. Current US food safety regulations require the use of HACCP principles by all meat, poultry, seafood, and juice processors.

Other technologies originally developed for space foods that have found their way into the supermarket include: rehydratable food (soups, casseroles, cereals); thermostabilized (heat processed) foods in cans or retortable pouches; and irradiated meat.

Food for the Future

One of the most significant issues that is driving new food product development today is the heightened consumer interest in the relationship between eating and health. The term “functional foods” has entered our vocabulary to describe foods and food components that provide specific health benefits beyond basic nutrition. Functional foods can be unprocessed fruits, vegetables, or grain products, but the term also applies to an array of newer processed foods that utilize innovative technologies. Examples include orange juice fortified with calcium, pasta fortified with omega-3 fatty acids, and the development of spreads and salad dressings containing plant sterol and stanol esters that have been shown to reduce cholesterol.

Processed foods are an important part of our past and it appears they are poised to play a significant role in our future as well.



Space Crunch
For his 1962, flight Mercury astronaut Scott Carpenter snacked on compressed bars of cereal with raisins and almonds. Today we call these granola bars.

“The Greatest Thing Since Sliced Bread”

We can thank the food industry for this standard by which to measure all inventive technologies. In 1928 Otto Frederick Rohwedder, a jeweler in St. Joseph, Mo., perfected his machine that coupled bread slicing and automatic wrapping. The invention helped popularize pre-sliced bread and led to yet another innovation—the pop-up toaster.

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Vitamin D in the Spotlight:

by children and adults, adolescent girls and adult women had the lowest intakes of vitamin D from food.

Among adults, only four percent of men and one percent of women aged 50 and older met or exceeded the recommended intake.

Deficiency is prevalent in solely breastfed infants who do not receive vitamin D supplementation. Infants and young children with insufficient vitamin D can experience growth retardation and bone deformities known as rickets. Since reports of rickets have reemerged in the US, the American Academy of Pediatrics recommends that all breastfed infants receive 200 IU of vitamin D per day.

A conference, "Vitamin D and Health in the 21st Century: An Update," was held recently at the National Institutes of Health and included discussion of an evidence-based review on vitamin D and bone health. The review identified the need for future research, in less-studied populations such as infants, children, pre-menopausal women, and diverse racial or ethnic groups as well as dose-response relationships linking vitamin D blood levels to health outcomes.

Cancer

A rapidly growing body of evidence links vitamin D with reduced risk of certain cancers. In a recent study of healthy women compared to women with newly diagnosed breast cancer, higher exposure to sunlight during adolescence was associated with a 35 percent reduction in breast cancer risk later in life. A significant risk reduction was also observed with drinking at least 10 glasses of vitamin D fortified milk per week. A review of recent findings suggests higher levels of vitamin D are also associated with decreased risk of colorectal and other gastrointestinal cancers. Observational studies also suggest a relationship between sufficient vitamin D status and reduced risk of prostate and ovarian

cancer. Furthermore, a study of postmenopausal women who increased their vitamin D intake by 1,100 IU reduced their risk of all cancers by 60 to 70 percent.

Cardiovascular Disease

The exact mechanism of how vitamin D protects against cardiovascular disease and hypertension is not well understood. Vitamin D is known to be a potent hormone for regulating renin, a blood pressure hormone, in the kidneys. It has been observed that people living at higher latitudes are at increased risk of developing hypertension, suggesting that sun exposure and vitamin D may protect against hypertension. One study found that patients with cardiovascular disease are more likely to develop heart failure if they are vitamin D deficient.

Autoimmune and Infectious Diseases

The role of vitamin D in the prevention of autoimmune disease requires further study, but studies suggest multiple sclerosis, rheumatoid arthritis, and type 1 diabetes may be associated with vitamin D deficiency. Living at a latitude above 37 degrees has been shown to increase risk of developing multiple sclerosis by 100 percent. A multivitamin supplement with 400 IU of vitamin D reduced risk by 40 percent in one study. Similarly, women taking 400 IU of vitamin D in a multivitamin supplement decreased their risk of rheumatoid arthritis by about 40 percent. Even more compelling is the observation that children in Finland who received 2,000 IU of vitamin D daily beginning at one year of age had an 80 percent reduced risk of developing type 1 diabetes over 25 years compared to children who were vitamin D deficient.

Recent research is emerging showing 1,25(OH)₂D may also boost the immune system. Studies show that 1,25(OH)₂D makes a protein that kills the bacteria that causes

tuberculosis. This mechanism may explain why African Americans, who are more likely to be vitamin D deficient, are more prone to contracting tuberculosis than Caucasians, and tend to have a more aggressive form of the disease.

How Much is Enough?

The current adequate intake (AI) for vitamin D is between 200 and 600 IU per day depending on an individual's age and sex. However, some experts recommend a minimum of 1,000 IU per day for adults to maintain a healthy level of circulating vitamin D, in addition to exposure to sunlight for five to 15 minutes per day (between 10 am and 3 pm). If outdoor activity lasts longer than five to 15 minutes, use of sunscreen is advised to reduce the risk of skin cancer.

Food sources of vitamin D are limited, and thus obtaining vitamin D solely through dietary sources can be challenging. Naturally occurring sources are limited mostly to oily fish (salmon, mackerel, sardines) and cod liver oil. Fortified foods and supplements are major dietary sources of vitamin D. Milk is fortified with vitamin D at 100 IU per cup. Some cereals and orange juices are also fortified.

In the US and Canada, the current dietary recommendations for vitamin D were set in 1997 by the Institute of Medicine. The AI for vitamin D was based on the intake necessary to achieve the estimated "normal" ranges of serum 25-hydroxyvitamin D concentrations assuming that there was no synthesis of vitamin D through sun exposure.

Since 1997, progress has been made toward determining optimal serum 25-hydroxyvitamin D concentrations. Many scientists believe an optimal level is 60-75 nmol/L or higher, which most experts agree cannot be reached with the

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Food Allergy or Food Intolerance: How Do You Tell the Difference?

The statement “I’m allergic to milk” is used quite often in normal conversation; however, true milk allergies in adults are not common. Instead of a milk allergy, a person making this comment is likely to be lactose *intolerant*. This confusion between food allergies and food intolerance is a frequent misconception; yet there are clear differences between the two. Food allergies involve an immune response, while food intolerances do not. Only about two to four percent of adults and six to eight percent of children under the age of three have true food allergies. Others reacting to foods most likely have food intolerance.

What is a food allergy?

A food allergy involves an abnormal immune response to a protein in a food. Over 170 foods have been documented as causing food allergies. Yet the eight major food allergens—cow’s milk, eggs, fish, crustaceans, peanuts, soybeans, tree nuts and wheat—account for over 90 percent of allergic reactions. After an initial exposure to the food allergen, the body assumes that the food is a harmful substance; thus antibodies to the food are created. Second and subsequent exposures cause the body to release chemicals into the blood stream that cause adverse reactions.

Reactions to food allergens range from mild to severe. Symptoms can occur within minutes to hours in an immediate reaction, while delayed reactions may not appear for 24 hours or more. Symptoms can affect the GI tract (nausea, vomiting, diarrhea, and cramping), skin (rashes, hives, and eczema), and the cardiovascular system.

Life-threatening allergic reactions, known as anaphylaxis, occur

rapidly and involve several body parts. Anaphylaxis symptoms can range from mild to severe and include itching, hives, swelling of the throat, difficulty breathing, hypotension, unconsciousness, and even death. The Food Allergy and Anaphylaxis Network (FAAN) estimates that between 150 and 200 people die annually from food-related anaphylaxis; therefore, immediate medical treatment is needed in the event that a person with a life-threatening allergy is exposed to the food allergen.

Do I have a food allergy?

If you suspect you have a food allergy, seek a board-certified allergist for diagnosis. A variety of methods such as a food diary, elimination diet, or a skin or blood test may be used by an allergist to safely evaluate whether you have a true food allergy.

Food Allergy Management

Management of food allergies starts simply by not consuming food containing the allergen. In some circumstances the allergen may not be apparent, such as peanuts in Pad Thai, or anchovies and/or sardines in Worcestershire sauce. Because allergens can be difficult to identify, individuals with food allergies must be well aware of what they are eating. In restaurants, individuals should explain their allergies thoroughly to restaurant staff, and ask them to check with the chef if they don’t know what ingredients are in a dish. At home and at the grocery store, individuals must pay attention to food labels—manufacturers of packaged foods are now required, by the Food Allergen Labeling and Consumer Protection Act (FALCPA), to list the eight major food allergens in plain English.

What is food intolerance?

A food intolerance is any form of food sensitivity or abnormal reaction that does not involve the immune system; consequently, symptoms are less severe and generally are not life threatening. There are three accepted types of food intolerances—anaphylactoid, metabolic and idiosyncratic reactions. Anaphylactoid reactions result from the ingestion of a substance that causes the release of histamine, such as an abnormal reaction to strawberries. Metabolic reactions arise when a food or component of a food cannot be metabolized normally. Lactose intolerance, caused by deficiencies of the enzyme lactase, is the most common example of a metabolic reaction. Idiosyncratic reactions, like sulfite-induced asthma, occur via unknown mechanisms.

Symptoms of food intolerances typically involve the gastrointestinal tract and include nausea, bloating, gas, cramps, vomiting, and diarrhea. Other reactions can occur such as headaches, irritability or nervousness. Symptoms arise from the body’s inability to properly digest the food, as in lactose intolerance, or the food itself irritating the digestive system.

Do I have food intolerance?

Since symptoms of food intolerance are similar to the flu and other common ailments, food intolerances can be difficult to identify. If food intolerance is suspected, assessment with trial and error can be used to determine the cause of the adverse reaction.

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Vitamin D in the Spotlight

currently recommended dietary intakes of vitamin D. Researchers recommend that blood concentrations of 25(OH)D be measured annually and if low, addressed with supplementation and/or increased sun exposure to raise serum levels.

Currently, the Tolerable Upper Intake Level (UL) for vitamin D is 2000 IU/day for all individuals one year and older. Yet, research has revealed that many individuals require a level of vitamin D above the UL to achieve optimal serum 25-hydroxyvitamin D concentrations. Risk assessment for higher intakes of vitamin D, based on the review of human intervention studies, found the absence of toxicity at vitamin D doses of 10,000 IU/day.

Increasing vitamin D intake is an easy measure to adopt that can have a positive impact on health status. To maximize vitamin D status, health experts recommend increasing vitamin D intake from vitamin D fortified foods, including milk, and vitamin D supplements, in combination with sensible sun exposure. Further review of vitamin D requirements could likely support an increase in recommended daily intakes of this important vitamin.

Spotlight on Gluten:

Celiac disease is sometimes considered a food allergy because it is the result of an adverse immune response to gluten, a protein found in wheat, barley and certain other grains. As such, individuals with Celiac Disease must follow a strict diet, which includes avoiding all foods containing gluten. Unlike some childhood food allergies, which are sometimes outgrown, Celiac Disease stays with you through your lifetime. The most common age for diagnosis is around 40, and most patients have had at least 10 years of symptoms before diagnosis.

For more information go to:

[Food Allergies & Asthma Backgrounder](#)

[Understanding Food Allergy Brochure](#)

[IFIC Review: Understanding Food Allergy](#)

[Questions and Answers about Food Allergy](#)

[Food Allergy Poster for Food Service Workers](#)

[School Foodservice and Food Allergies: What We Need to Know](#)

Other sources for information on Food Allergies:

[Food Allergy & Anaphylaxis Network \(FAAN\)](#)

[American Academy of Allergy, Asthma and Immunology \(AAAAI\)](#)

Food Sources and Recommended Intakes of Vitamin D

| Food | Vitamin D (IU) | Percent Daily Value (DV) * |
|---|----------------|----------------------------|
| Cod liver oil, 1 tbsp | 1,360 | 340 |
| Mackerel, cooked, 3 ½ ounces | 345 | 90 |
| Canned salmon, pink, with bones, drained, 3 oz | 396 | 99 |
| Tuna fish, light, canned in oil, 3 oz | 200 | 50 |
| Milk, fortified with vitamin D (nonfat, reduced fat, whole), 1 cup | 100 | 25 |
| Orange juice, fortified with calcium and vitamin D, 1 cup | 100 | 25 |
| Ready-to-eat cereals, fortified with 10% of the DV for vitamin D, ¾ or 1 cup (depending on brand) | 40 | 10 |
| Egg yolk, 1 large | 20 | 6 |
| Dietary Supplement | 400 | 100 |

*Based on Daily Value of 400 IU

Source: USDA National Nutrient Database for Standard Reference, Release 19, 2006.

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Food Intolerance Management

Unlike a true food allergy where the food must be avoided, individuals with food intolerance can ingest small amounts of the afflicting food. Reactions are usually related to frequency and amount of the food ingested; thus, small amounts are not likely to cause a significant reaction. Individuals with food intolerance can also choose to manage less severe symptoms instead of reducing the amount of food ingested.

What do I need to know about food allergies and intolerance?

If you have a food allergy, avoid the food. There is more flexibility with food intolerances—you can choose to eat small amounts only, or manage your symptoms. In either case, you should always be aware of what is in the foods you eat—whether from a grocer, restaurant, or your own kitchen. Awareness is the key to management.

What's New @ IFIC.ORG?

To help further the continuing education of dietitians, the IFIC Foundation has developed several new American Dietetic Association (ADA)-approved continuing professional education (CPE) online programs. Topics explored in the CPE modules include: Sugar Alcohols, Fats in Food, Carbohydrates and Health, Caffeine and Health, Functional Foods, the relationship of Food Science and Nutrition, and Food Sensitivities. Registered dietitians and dietetic technicians can earn one CPE credit hour for each program completed. For more information, visit the IFIC Foundation Web site at <http://www.ific.org/adacpe/index.cfm>

Diabetic Nutrition can Include Sweets

Consuming too many carbs and too much sugar can cause insulin levels in people with diabetes to soar, so it is important that they watch their intakes carefully. Fortunately, those managing diabetes do not have to go through life without sweets—they can utilize low-calorie sweeteners to satisfy their sweet tooth.

Low-calorie sweeteners are added to foods and beverages to provide sweetness without adding a lot of calories. They are hundreds to thousands of times sweeter than sugar; therefore, they can be used in very small amounts.

The five US approved low-calorie sweeteners are: acesulfame-potassium (or Ace-K), aspartame, neotame, saccharin, and sucralose. These sweeteners have been studied extensively and approved as safe food ingredients by the US Food and Drug Administration (FDA).

Most low-calorie sweeteners are not metabolized by the body and contribute few to no calories.

As a result, people with diabetes can use them to regulate carb and sugar intake, as well as help with weight loss. “A typical 20-ounce carbonated beverage may have 16 teaspoons of sugar. Drinking a diet soda instead of a regular soda can save about 256 calories and 64 grams of carbs.” (Diabetes Care and Education handout “Sweet Taste, Without the Calories”)

According to the American Diabetes Association, low-calorie sweeteners “make food taste sweet, and have no calories and do not raise blood glucose levels. They do not count as a carbohydrate, a fat, or any other exchange.”

Low-calorie sweeteners can play a safe and important role in healthful food choices for people with diabetes. Their use can provide alternatives for individuals concerned with calorie and carbohydrate intake and are safe for the general public, including people with diabetes.

Resources:

Diabetes Care and Education Handout “Sweet Taste, Without the Calories” (developed in partnership with IFIC Foundation):
<http://www.ific.org/publications/brochures/dceslick.cfm>

Facts About Low-Calorie Sweeteners:
<http://www.ific.org/publications/factsheets/lcsfs.cfm>

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Vitamin D in the Spotlight

AI for Vitamin D*

| Age | Children (IU/day) | Men (IU/day) | Women (IU/day) | Pregnancy & Lactation (IU/day) |
|-------------------|-------------------|--------------|----------------|--------------------------------|
| Birth to 13 years | 200 IU | | | |
| 14 to 18 years | | 200 IU | 200 IU | 200 IU |
| 19 to 50 years | | 200 IU | 200 IU | 200 IU |
| 51 to 70 years | | 400 IU | 400 IU | |
| 71+ years | | 600 IU | 600 IU | |

*Assumes absence of adequate sun exposure.

Source: Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes: Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride. National Academy Press, Washington, DC, 1999.



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