



## Oncology Providers' Opinions on Neutropenic Diet and Safe Food Handling: A Descriptive Qualitative Study

### ABSTRACT

Traditionally, cancer patients are prescribed a neutropenic diet to reduce the risk of infection. The diet is restrictive and leads to the patients being dissatisfied. There has been a trend to replace a neutropenic diet with safe food handling, which allows patients to have more food options and places emphasis on how food should be safely handled. Semistructured interviews were conducted with nine oncology providers to understand their opinions on a neutropenic diet, prescription behavior, patient dietary education, and attitudes on the safe food handling approach. Results showed that seven of the nine providers agreed with the neutropenic diet, while two disagreed. Five providers prescribed the neutropenic diet on the basis of different criteria. Patients' dietary education varied in content and format among providers. Only two of nine providers were aware of a safe food handling approach. Six of nine providers supported the replacement of a neutropenic diet to a safe food handling approach after background information was provided, with one against the replacement, and two supported a combination. These results demonstrated the

inconsistency of the neutropenic diet implementation and patient dietary education at the provider level, which could inform changes in how neutropenic diets are handled in a healthcare setting.

### INTRODUCTION

Cancer patients undergoing myelosuppressive therapy are at the greatest risk of developing neutropenia. Technically, neutropenia is defined as an absolute neutrophil count (ANC) of less than 2,000 cells/ $\mu$ l (1), whereas severe neutropenia occurs when the ANC falls below 1,000 to 500 cells/ $\mu$ l (16). Patients who are diagnosed with neutropenia were normally prescribed a neutropenic diet, with the purpose of reducing infection. The proposal of a restricted diet first came to fruition in the 1960s when studies demonstrated the feasibility of a strictly isolated laminar airflow unit, also called a life island, to care for hospitalized neutropenic patients (14). Patients were prescribed the sterile diet with food items sanitized by autoclaving, irradiation, or occasionally by oven baking (27). Studies reviewing the effectiveness of the sterile diet concluded that it afforded little to no advantage over a low microbial

\*Author for correspondence: Phone: +1 225.578.3997; Fax: +1 225.578.4443; Email: wenqing.xu@agcenter.lsu.edu

diet and that patient noncompliance was a potential problem (2, 17, 18). As time went by, the sterile diet became more liberalized, allowing for the emergence of what is known today as a neutropenic diet. In some studies, the neutropenic diet was sometimes referred to as a “low-bacteria diet,” “low-microbial diet,” and “reduced bacteria diet” (28). The neutropenic diet focuses on placing restrictions on certain food items. However, a few studies have compared a neutropenic diet to a regular diet while examining the rate of infection in patients and reported no significant evidence to justify prescribing the neutropenic diet (12). In addition, the neutropenic diet restrictions vary among institutions and even among providers in the same institution (4). Besides the ineffectiveness and inconsistency, the neutropenic diet may lead to nutrient deficiencies and patient dissatisfaction due to a lack of variety in the diet (22). Therefore, some institutions who made the transition from the neutropenic diet to safe food handling approach have proven practicing food safety and proper food handling are effective in preventing infection among patients (9, 25), while others are hesitant to make the change. The safe food handling approach focuses on four steps of food safety, “clean,” “separate,” “cook,” and “chill,” when handling food, detailed in the *Food Safety for Older Adults and People with Cancer, Diabetes, HIV/AIDS, Organ Transplants, and Autoimmune Diseases booklet of the U.S. Food and Drug Administration (FDA)* (26).

Physicians are considered the most credible source of information about health in the United States (31). However, several studies have reported inconsistencies in their opinions regarding prescribing practices and documentation (8, 19, 24). Cook et al. (6) reported that the healthcare providers expressed a clear need for information related to food safety during pregnancy and listeriosis, as supported by their lack of knowledge in these areas. Wohlgenant et al. (29) conducted a focus group study and revealed healthcare providers lack training, knowledge, and willingness to provide food safety information to older adults. Therefore, campaigns about food safety education targeted for doctors have been recommended (30).

There has been little research examining the health providers who treat cancer patients prescribing the neutropenic diet or attitudes on replacing it with a safe food handling approach. A semistructured interview was conducted to answer the following three questions:

- (i) What do oncology providers know about the neutropenic diet?
- (ii) What beliefs and attitudes do oncology providers have regarding the neutropenic diet?
- (iii) How do oncology providers feel about implementing a safe food handling guideline in replacement of the neutropenic diet?

## METHODS

### Ethical consideration of study

The study presents minimal to no risk for participants, and data were deidentified to protect confidentiality and

anonymity. If mentioned, identifying information, such as names and workplace, were redacted from the transcriptions, and each participant was assigned a researcher-generated identification number. All participants were provided with a letter of informed consent that noted the purpose of the study, the procedure that would be done, the potential risks and benefits of the study, and how the data would be handled, stored, and discarded. Every participant provided verbal consent prior to data collection, and a signed letter of consent was obtained from every participant for proper documentation. This research study was reviewed and approved by the Louisiana State University AgCenter (HE20-17) and Franciscan Missionaries of Our Lady University Institutional Review Board (2020-071) to ensure ethical compliance and protection of human subjects.

### Interview question design

Semi-structured interviews were conducted to collect data from healthcare professionals. The interview guide, Healthcare Professionals Overseeing Immunocompromised Patients and the Neutropenic Diet, consisted of six questions (*Table 1*). A draft interview instrument was distributed to five content experts, and feedback was gathered through email comments, as well as through in-person discussion.

### Participant recruitment and selection

To begin the recruitment process, the researcher identified potential study participants by searching on healthcare facilities' websites in Louisiana and Mississippi. Oncology providers who met the study criteria were sent a recruitment email. Subsequent recruitment efforts involved calling potential participants or recruiting participants in person. Each potential provider was asked to participate in the study through an interview or written survey. To be included in the study, all participants were to complete and return a letter of informed consent that detailed the objective and purpose of the study. The research team sought to obtain 20 provider interviews for a broad overview of the beliefs of oncology providers. Although not made known to the participants during the recruitment process, all participants received financial compensation upon completion of the study. A total of 91 invitations were distributed, with a response rate of 9.89%.

Purposive sampling was used to select the study participants. All providers who responded to the recruitment efforts of the researcher and met the inclusion criteria of the study were selected. Inclusion criteria included participants being an active medical oncology physician, nurse practitioner, or physician assistant and practicing in the United States. Oncology providers who specialized in radiation or surgery, as well as retired providers, or providers practicing outside of the United States were excluded from the study.

**TABLE 1. Interview questions and oncology provider responses (n = 9)**

Questions/response themes	No. of responses
1. Regarding patient safety and vulnerability, what are your thoughts on the neutropenic diet?	
• Agree	7 (n = 9)
• Disagree	2 (n = 9)
2. Do you prescribe the neutropenic diet to your patients? If so, when do you determine the need to place them on this diet restriction?	
• Prescribes neutropenic diet for chemotherapy patients	2 (n = 9)
• Prescribes neutropenic diet based on absolute neutrophil count	2 (n = 9)
• Prescribes neutropenic diet based on setting	1 (n = 9)
• Does not prescribe neutropenic diet	3 (n = 9)
• Does a combination	1 (n = 9)
3. Do you provide diet education to your patients who are undergoing immunosuppressive therapy? If so, can you briefly describe what the education involves?	
• Neutropenic precautions	5 (n = 9)
• Food safety	2 (n = 9)
• General healthy eating habits	2 (n = 9)
4. Have you heard of a safe food handling diet? If so, what do you know?	
• Aware	2 (n = 9)
• Unaware	7 (n = 9)
5. The U.S. Food Drug Administration (FDA) and American Cancer Society (ACS) recommend patients undergoing immunosuppressive therapy should follow a safe food handling approach that involves proper management of temperatures during storage and cooking of food items, sanitation efforts in the preparation and storage of food, and avoidance of risks at grocery stores and when dining out. Noting this, how do you feel about replacing the neutropenic diet with a safe food handling diet?	
• Supports replacement	6 (n = 9)
• Against replacement	1 (n = 9)
• Supports a combination	2 (n = 9)
6. If your organization or practice decided to move toward a safe food handling approach, do you have any suggestions or recommendations on how this new approach can be implemented? [OR] If the organization already uses a safe food handling approach, did you face any challenges during the implementation process, and if so, do you have any recommendations to help overcome these challenges?	
• Employee training	1 (n = 9)
• Offer financial support to patients	1 (n = 9)
• Involve nutrition department	2 (n = 9)
• Provide handouts	1 (n = 9)
• Include information in chemotherapy education	1 (n = 9)
• Avoid influx of information	1 (n = 9)
• Repeat information	2 (n = 9)
• Terminology challenge	1 (n = 9)

## Interview process and data collection

Prior to the interview process, interviewers completed Collaborative Institutional Training Initiative training for social-behavioral-educational comprehensive researchers and conducted several mock interview sessions prior to the actual interviews. Data were collected between 13 August 2020, and 24 October 2020. Due to visitation restrictions during the COVID-19 pandemic, data collection was originally planned to be one-on-one interviews over Zoom. Sensing that some potential participants were hesitant to participate because they would have to download the Zoom program, the researcher also offered telephone interviews. One participant had significant time constraints, so a written survey was offered. In total, data collection involved five interviews over Zoom, three telephone interviews, and one written survey ( $n = 9$ ). Each of the eight oral interviews were guided by using the semi-structured interview guide and recorded by using Zoom. The length of the oral interviews ranged from 8 min and 12 s to 21 min and 40 s, with an average interview length of 11 min and 33 s. The written survey followed the same interview questions and order as the oral interviews. All recordings and the written survey responses were stored on a password-protected device.

After the interviews were conducted, the audio recordings were transcribed via Otter.ai (Otter, Mountain View, CA). Possible external threats during data collection include interpretative validity that can occur during the transcription of data from audio recordings to typed responses. To combat this, researchers manually checked the transcriptions for accuracy in multiple passes. All participants were sent the respective transcript to check for correctness (7), and no participants identified necessary changes to the transcriptions.

## Data analysis

Similar trends among beliefs, current practice, knowledge, and attitudes within the sample population regarding the neutropenic diet and food safety practices were identified among transcriptions. The corrected transcriptions and the written survey response were then uploaded into MAXQDA (11). Each participant interview was initially coded with holistic coding. This form of coding can be considered “macro-level” coding and involves applying a single code to a large unit of data (20). The initial holistic codes identified the participants’ responses to the six interview questions (20). The descriptive coding helped to group similar responses. The third round of coding used in vivo coding to code the data on the basis of the specific language used by the participants (20). *Figure 1* displayed the coding process and codes used in the analysis of the data. After the thematic analysis was complete, the results were organized into *Table 1* to display the underlying themes of the data. The frequency of similar attitudes, beliefs, and knowledge of the neutropenic diet among the participants were also organized in *Table 1*.

## RESULTS

### Participant characteristics

Data collection ceased at nine participants because inductive thematic saturation was achieved (21). The saturation point was chosen when additional data did not contribute to the number of new codes or emerging themes (10). Among the nine participants selected, three were male, and six were female. The sample consisted of four physicians, three nurse practitioners, and two physician assistants. Two participants specialized in pediatric hematology and oncology, three of the participants primarily specialized in hematology and oncology, and the remaining four participants specialized in cancer care. Six of the participants also had additional specialties including hematology and oncology, oncology, breast cancer, lung cancer care, pancreatic cancer care, pediatric cancer, and general cancer care. During the study, participants were employed by three different healthcare facilities in Louisiana.

### Oncology provider thoughts on the neutropenic diet

As shown in *Table 1*, generally, when asked their thoughts on the neutropenic diet regarding patient safety and vulnerability, seven of the nine providers agreed with the neutropenic diet, while two providers disagree with the neutropenic diet. Interestingly, the providers who were against the neutropenic diet had reasons for their attitudes toward the diet, but those in favor of the diet did not offer strong reasons for their convictions. Participant 9 stated that “I do agree with it. I give patients ... precautions on what to eat and what not to eat.” Interestingly, participant 8 noted that there was no strong data to support the use of or need to abandon the neutropenic diet, but then stated that he/she would “always favor ... a carefully selected diet program for patients who are neutropenic, especially those with bone marrow disorders like leukemia.” When asked to further elaborate on their agreement with neutropenic diet revealed the inconsistency of the diet definition among providers. Participant 2 defined it as “safety comes first ... not eating anything raw, making sure things are washed and cleaned ... like fruits and vegetables before they [patients] eat them. ... stay away from things [foods] that ... have sat out for over an hour.” Participant 6 stated “my definition of a neutropenic diet is making sure all foods are cooked well and eating no fruits or vegetables without a thick skin.” Participant 4 stated that:

avoiding raw meats, raw fish, washing your fruits and vegetables. ... the fruits with peels are obviously better: bananas, oranges, versus grapes or strawberries. We recommend they do not eat salad that is not prepared at home. So, no salads. ... definitely no buffets, period. No salads at restaurants.

The other two providers disagreed with the use of the neutropenic diet. When asked to elaborate on the disagreement, participants stated that they felt that the diet causes more harm than good. Participant 3 expressed concerns on patients’ nutrient intake and satisfaction:

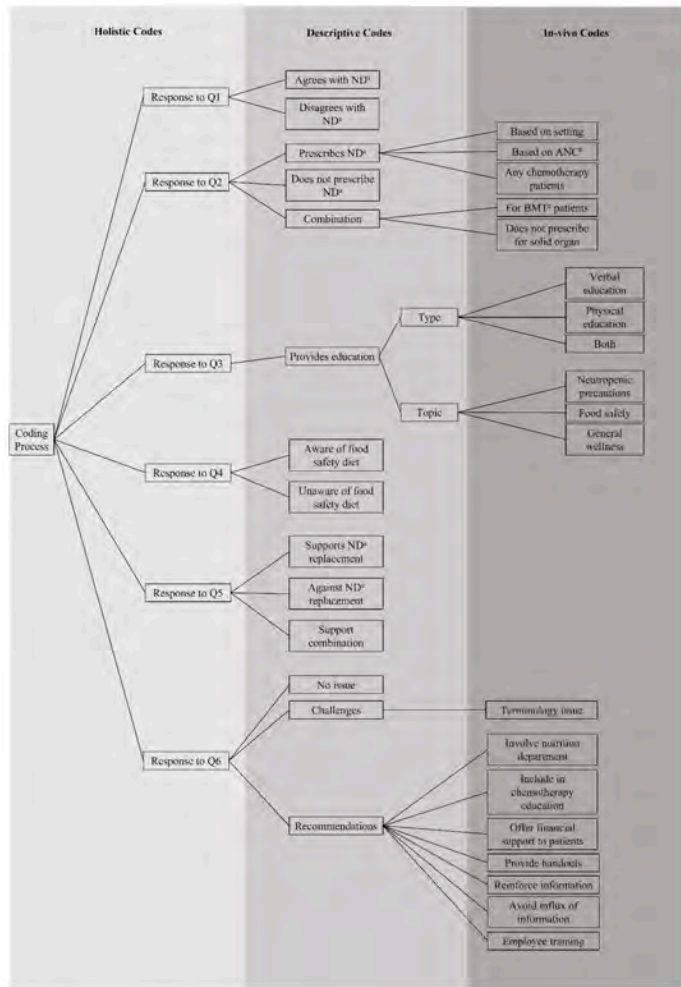


Figure 1. Coding process

Figure 1. Coding process. Participants' responses for six interview questions were coded by using holistic, descriptive, and in vivo coding, color coded in light gray, gray, and dark gray, respectively.

<sup>a</sup>ND, neutropenic diet.

<sup>b</sup>ANC, absolute neutrophil count.

<sup>c</sup>BMT, bone marrow transplant.

I feel like it gets twisted. And we're like, well, we want you to eat everything that's processed. We want you to eat ... canned vegetables rather than, you know, the fresh fruits and vegetables that are probably soaked in salt. It just feels counterproductive ... it's harmful when my patients are ... undergoing like taste changes, or they really don't want to eat. And the only thing they want to eat is what we're telling them not to, like a salad. ... So, I think it's more harmful in that way in that it decreases the options available to this patient population that already has so many issues regarding eating, like a decreased taste, appetite, so many things change, they get mouth sores. There's a lot of battles we're already fighting, and I don't want this to be one of them.

The same participant also acknowledged that neutropenic diet lacks research support, who stated "and it's like, I can't tell my patient, the one thing they want is not good for them because I really don't have any research or data to support that."

### Prescription of a neutropenic diet

As shown in *Table 1*, six of the nine participants reported that they prescribe the neutropenic diet to their patients; however, the criteria that trigger the prescription was inconsistent among providers. Two participants noted that they automatically prescribe the diet once a patient starts the chemotherapy. Participant 1 stated

we don't necessarily wait for them to become neutropenic. If they're on immunosuppressive chemotherapy, it is going to happen at some point, and it's very difficult to turn things on and off ... like a switch. So, families are instructed to adhere to some of these common requirements throughout their treatment regardless of whether they are actually neutropenic or only potentially going to become neutropenic. We feel like it'll happen at some point. So, you want to be ready for it.

Another three participants who prescribe the diet noted that they place their patients on a neutropenic diet restriction

based on their ANC. One participant noted that they prescribe a neutropenic diet based on a combination the previous two criteria, ANC and chemotherapy. Participants 5 and 9 both noted that they place their patients on the neutropenic diet restriction when the patient's ANC is below 1,500 cells/ $\mu$ l.

The other three remaining participants reported that they do not place their patients on a neutropenic diet restriction. Interestingly, one of these providers noted that they restrict their cancer patients from eating seafood to reduce the risk of *Vibrio vulnificus* infections.

#### **Diet education provided to immunosuppressive therapy patients**

All nine participants stated that they provide dietary education to their patients (Table 1). Five of the participants noted that the education covers neutropenic precautions, two of the participants stated that the education covers food safety topics, and two of the participants noted that education covers general wellness during cancer treatment. Five of the participants also described the specific form of the education provided to their patients. One reported using the verbal form, two reported using physical handouts, and two reported a combination of the two. The other four participants did not specify the format of the patient diet education. Participant 4 described the difference between medical oncology and bone marrow transplant patients when it came to diet education:

we discuss the neutropenic diet very briefly ... on the Medoc [medical oncology] side ... we don't say no fresh fruits or vegetables. We talk about washing things appropriately. We also have two dietitians on our staff that if we see someone is struggling or having repeated infections, we will refer them to the dietitians. On the BMT [bone marrow transplant] side, it is completely different. They get handouts. They get strict education from the nurse practitioners. They get strict education from the dietitian. The dietitian will see them pretransplant and walk them through the neutropenic diet. They will also see them post-transplant before hospital discharge. The nurse practitioner will also see them before hospital discharge post-transplant and reinforce the neutropenic diet. And, of course, they get handouts, many, many handouts on what is appropriate.

#### **Awareness of safe food handling approach**

When participants were asked if they were familiar with the safe food handling approach recommended by the FDA (26) and American Cancer Society (3), seven of the participants reported that they never heard of the safe food handling approach, while the other two reported some familiarity. The interpretation of safe food handling, however, was not accurate. Participant 2 stated "so what I have heard ... safe handling ... processes that they go through ... wash the foods properly, make sure that you don't eat anything raw. ..." The same participant also provided some details about the interpretation:

not drinking any tea, not having any sort of rice, certainly not having any sort of raw fish including oysters, and all the crazy things we'd like to eat here in Louisiana. They also have some soft cheese things too ... that you don't eat. So that's kind of what I know about safe food diet. If you go to a supermarket and they have samples and things like that, don't eat those samples. Make sure that you freshly cook things and make sure that you wash your hands during preparation and wash surfaces during preparation, of any sort of foods that you're cooking.

#### **Feelings toward replacing the neutropenic diet with a safe food handling approach**

As shown in Table 1, after giving a brief overview of the safe food handling approach from FDA and American Cancer Society, six of the nine providers reported that they would support replacing the neutropenic diet with a safe food handling approach. Participant 3 stated "I fully support that considering that's what I do already," and participant 8 stated "I would definitely prefer ... that over neutropenic diet." Two of the participants felt that a combined approach would be appropriate, and one participant felt that the neutropenic diet should not be replaced. Participant 6 was against the replacement of the neutropenic diet and stated "in my opinion, a neutropenic diet and safe handling diet are two separate entities, and both should be in place with immunocompromised patients." The shift in attitudes suggests the providers were not necessarily in favor of a neutropenic diet. Rather, they may have been unaware of more appropriate dietary suggestions for the patients.

#### **Challenges and recommendations for implementation of safe food handling approach**

When asked to offer suggestions or recommendations on how to implement the shift from a neutropenic diet to a safe food handling approach, if their organization decided to do so, the participants had varied responses. Recommendations included ensuring that the information about the safe food handling approach is continually repeated, including the information in chemotherapy education, and providing patients with handouts to take home. Two participants recommended involving the nutrition department to implement the change. Participant 3 stated:

"I feel like I would really utilize my nutrition department to try to get the ball rolling in that direction and have them kind of spearhead it, considering that's their specialty, and I'm sure they influence a lot of the policies." One participant noted a possible challenge of changing the recommended diet for cancer patients. The provider noted that there would likely be a challenge for patients to shift the terminology between the neutropenic diet and safe food handling.

#### **DISCUSSION**

Our results demonstrated the inconsistency of neutropenic diet, including its (i) definition, (ii) usage, and (iii) initiation.

(i) There were few similarities among the participants regarding the definition of a neutropenic diet in terms of what food to restrict. This inconsistency was supported by the literature. Certain neutropenic diet restrictions excluded raw foods, such as uncooked fruits and vegetables, while others allowed raw fresh produce. Some restrict fruits that cannot be peeled, raw vegetables, herbs, and sprouts (4). Raisins, nuts, and other dried fruits were allowed in some institutions but not all (13).

(ii) When it comes to the usage of the neutropenic diet, this study agreed with Brown et al. (5) who reported neutropenic diet inconsistencies among 20 top cancer centers in the United States. Seven of the top 20 hospitals made recommendations for the neutropenic diet, although only one hospital provided evidence in the literature to support this recommendation. Four hospitals recommended against the neutropenic diet, and all provided evidence in the literature to support this recommendation. The remaining nine hospitals did not provide any information about a neutropenic diet on their public websites. Seven websites mentioned the use of the FDA's safe food handling guidelines (5).

(iii) In addition to dietary restrictions, significant inconsistencies were reported among physicians when initiating the neutropenic diet. Braun et al. (4) reported significant differences in the initiation, discontinuation, and specific food restrictions of a neutropenic diet among 557 physicians across 174 institutions. Even more alarming, our study revealed that participants from the same facility had varying definitions of the neutropenic guidelines.

The main limitation of this study was the use of a small purposive sample. However, inductive thematic saturation was reached, and some consistencies were observed between our findings and published research. Another limitation was the use of different methods for data collection due to the COVID-19 pandemic visiting restrictions. However, it was assumed that participants were experienced oncology providers and possessed knowledge related to the subject matter.

## CONCLUSIONS AND RECOMMENDATIONS

This qualitative descriptive study support that there were inconsistencies among oncology providers on the definition of the neutropenic diet. There were also discrepancies among providers regarding the patients who need to be prescribed a neutropenic diet, as well as the timing of when the restriction should be placed. Although all providers acknowledged that patient education was imperative, it was important

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to educate the patient on the most appropriate diet for immunocompromised patients. Most of the providers felt that a safe food handling approach would be beneficial to their patients than the neutropenic diet, there was still some hesitation among providers to replace the neutropenic diet.

Because of the inconsistency of neutropenic diet reported in this study, as well as low effectiveness of the restrictive diet against patients' infection rate reported by previous researchers (15, 23), we recommend to liberalize the neutropenic diet or completely replace it with safe food handling approach. A liberalized and balanced diet may increase patients' satisfaction. For the benefit of immunocompromised patients, a standardized dietary prescription protocol should be followed by all oncology providers. Policies and procedures for food and nutrition services, including the foodservice staff should also be created to enforce strict adherence to food safety measures. Standardized food safety education should be provided to food and nutrition staff as well as the immunocompromised patients. All parties involved in the treatment process of oncology patients should receive the same education to promote clarity and continuity of patient care. Clinical dietitians may play an important role in food safety education.

A foreseeable challenge to this recommendation is a lack of labor available for the implementation process. Unlike nursing personnel, healthcare facilities oftentimes only employ a limited number of registered dietitians. The initial switch from a neutropenic diet to a safe food handling approach will require sustained effort from the dietitians, foodservice management, and foodservice staff in the facility, but this necessary effort may not be feasible given the day-to-day job demands. Another challenge to the shift is the typically high turnover rate of the food and nutrition department staff. If a facility is consistently hiring new kitchen employees, it would be difficult to ensure that all employees are receiving the same education about the importance of food safety measures for the health of the patients. To address this challenge, ongoing training and scheduled in-services on food safety should be embedded in the food and nutrition department's ongoing staff education.

## ACKNOWLEDGMENTS

This work was supported by the U.S. Department of Agriculture, National Institute of Food and Agriculture, Hatch Project (grant 1023870) and Franciscan Missionaries of Our Lady University under a grant from the Sister Marie Therese Crowley Endowed Professorship funds.

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