Message from the Chair

I hope this message finds you and your families in good health and spirits. Originally, my note to you was one of excitement and anticipation for the upcoming Oncology Nutrition Symposium. Now, shortly after the decision was made to cancel the symposium, a feeling of disappointment is heavy in my heart, as I know it is in yours as well. Please know that this was a difficult decision, but it was done out of concern for the seriousness of the COVID-19 pandemic’s impact on public health. We want you to have the best chance to stay strong and healthy and continue to care for your families and your patients.

Rest assured we are working hard as an Executive Committee to offer additional opportunities for enhanced online learning so that we may provide you with as much of the content originally planned for the symposium as we can. We have been noting your suggestions on the discussion board and social media, but please feel free to reach out to me directly as well. As always, your input is greatly valued; we are only successful as a DPG if we can meet the needs of our members. On that note, you will be receiving the annual member survey soon – please look for this and provide your feedback.

We have witnessed the popularity of the symposium grow from year to year, so much so that we sold out much sooner than anticipated. Hopefully, with future symposiums, we will be able to accommodate a greater number of participants, so that more members will benefit from the indispensable opportunities for learning and networking offered there. We thank you for your patience with us as we continue to learn and grow as an organization, and for your flexibility during these uncharted periods of uncertainty.

Aside from the symposium, we are continually striving to connect members with...
the resources and support you need to deliver excellent patient care, and continue to grow as oncology nutrition practitioners. We have some new and exciting ideas in the works – so stay tuned.

Finally, I want to end with a quote from one of my favorites, Brené Brown, to remind you that during these uncertain times it is leaning on each other and embracing our global interconnectedness that will make us stronger together.

“Somehow we’ve come to equate success with not needing anyone. Many of us are willing to extend a helping hand, but we’re very reluctant to reach out for help when we need it ourselves. It’s as if we’ve divided the world into ‘those who offer help’ and ‘those who need help.’ The truth is that we are both.”

As you extend yourselves to help others during these uncertain times, please don’t forget to take care of yourself in the process. We’re all in this together.

Stay well,

[Signature]

PAYMENT MATTERS

Understanding the basics of healthcare payment and reimbursement for the services you provide is an asset to every RDN, no matter where you work. If you understand where the money comes from, you put yourself in a better position to negotiate salaries and secure the future of the profession.

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Laying the Foundation for Improved Access to Oncology Nutrition Services


By Suzanne Dixon, MPH, MS, RDN

Ask any oncology dietitian about their workload and you’re likely to hear some refrain of, “too many patients, not enough time.” Anecdotes suggest there are many more cancer patients at risk of malnutrition than can be seen given current dietitian staffing levels in outpatient cancer clinics. But solid numbers are harder to come by. What do typical oncology RDN provider-to-patient ratios look like?

In late 2019, several members of the Oncology Nutrition Dietetic Practice Group (ON DPG) published a paper to answer this question. The group conducted a national survey of dietitian staffing and nutrition screening patterns in 215 cancer centers across the United States.

The full paper is available in the November 22, 2019 issue of the open-access publication, Journal of Oncology (1). Below is a brief review of the study and key findings from this important paper.

The Origins of a National Survey

The effort to better understand the state of outpatient oncology nutrition services began with one determined RDN working at the University of Colorado Cancer Center. Colleen Gill, MS, RDN suspected her comprehensive cancer center nutrition services department was understaffed. She needed to prove this to justify additional dietitian full-time equivalents (FTEs).

Colleen developed a survey focused predominantly on comprehensive cancer centers and distributed it electronically in 2011, and again in 2013. With plenty of phone and email follow up, Colleen gathered the necessary data to prove her case. She eventually added several additional RD FTEs to her cancer center’s staffing. While she didn’t officially publish her findings, Colleen shared her data widely through lectures, meetings and conferences.

Building on Colleen’s initial survey, several ON DPG members relaunched an updated version in December 2017 and data collection continued through July 2018. This allowed the group to collect data from 215 unique cancer centers. Responding facilities were a mix of large comprehensive centers affiliated with academic institutions and community programs in cities of various sizes.

Lack of Benchmarks and Unrealized Benefits of Medical Nutrition Therapy

There is limited benchmarking data to assess nutrition care in ambulatory chemotherapy and radiation therapy clinics. The survey aimed to address this data gap. The primary objective of the study was to evaluate existing staffing patterns in outpatient cancer centers employing RDNs. Secondary objectives were to determine RDN-to-patient ratios, malnutrition screening practices, and current billing patterns for nutrition services.

The online survey was distributed through the ON DPG electronic mailing list (EML) and included 18 quantitative and qualitative questions. After removing responses that did not meet study inclusion criteria and partial or duplicate answers, 215 surveys, each representing a unique cancer center (CC), were included in the final analysis.

Key Takeaways from the First National Oncology RDN Staffing Survey

Both NCI-designated CCs and non-NCI CCs responded to the survey. Out of 215 respondents, 42 were NCI CCs, representing 66.7% of all NCI CCs in the U.S. The remaining 173 surveys came from non-NCI designated institutions.

RDN-to-Patient Ratios Are Very High

If you’re an oncology dietitian and you feel overwhelmed at work, there’s a good reason for that. The average ratio of RDNs to patients in outpatient cancer care programs is 1:2,308. Consider oncologist staffing for comparison.

According to the 2018 Global Survey of Clinical Oncology Workforce (2), the ratio of new cancer cases to clinical oncologists in the U.S. is 137:1. In Canada this ratio is 352:1, in Germany it is 170:1, and in the United Kingdom it is 689:1. While no one would argue the ratio of dietitians to cancer patients should match that of oncologists, it is clear there are far too many patients for even the most dedicated oncology dietitian to manage properly.

Screening Rates Need to Improve, Barriers to Screening Persist

A little more than half (53%) of cancer centers indicated that they consistently screen for malnutrition, and 65% use a validated malnutrition screening tool such as the Patient-Generated Subjective Global Assessment (PG-SGA), the Malnutrition Screening Tool (MST), the PG-SGA Short Form (PG-SGA SF), or the Malnutrition Universal Screening Tool (MUST). NCI-designated CCs were somewhat less likely to screen consistently (45.2%) compared with non-NCI CCs (55.4%).

Among clinics without consistent malnutrition screening in place, the most commonly reported barriers to screening were:

- Lack of a referral process (46.9%)
- Little-to-no administrative support (46.9%)
- Time constraints (45.3%)
- No identified screening tool (31.3%)
- Little-to-no nursing support (29.7%)
- Other disciplines do not agree on which screening tool to use (25%)

(Continued on next page)
Among all CCs, the most frequent mechanism for cancer patient referrals was sporadic identification by clinic or infusion staff such as physicians, nurses, nurse practitioners, and medical assistants. Direct chart review by RDNs was another common way of identifying patients at risk of malnutrition.

Most cancer centers (76.8%) reported not billing for nutrition services, with similar rates of non-billing between NCI CCs (72.7%) and non-NCI CCs (78.0%).

**Understaffing RDNs and Misperceptions Regarding Efficacy of Medical Nutrition Therapy**

Although the study was not designed to examine the efficacy of cancer nutrition interventions, many dietitians share anecdotes within professional circles regarding the harms of haphazard referral processes. Because patients are not screened or triaged appropriately, when RDNs do see them, nutrition interventions have limited efficacy.

Many dietitians talk about receiving predominantly “train wreck referrals,” that is, referrals that read, for example, “Patient has lost 36 pounds; please evaluate.” By this stage, the scope and impact of RD intervention is extremely limited and reinforces the idea nutrition care cannot improve cancer outcomes.

**Room for Improvement**

With slightly more than half of CCs consistently screening for malnutrition and many failing to use validated screening tools, we have a lot of room for improvement. Although it can seem overwhelming to screen for malnutrition, failing to do so means we reinforce the idea that weight loss and malnutrition are an inevitable part of cancer treatment. They are not.

While patients with advanced disease often experience intractable cachexia and wasting that is unresponsive to medical nutrition therapy (MNT), many do respond well when MNT is implemented early in the cancer care process, before significant malnutrition develops. Patients treated with curative intent, in particular, can respond very well to comprehensive nutrition assessment and intervention.

**Early Intervention is Critical to Successful Patient Outcomes**

The 2017 PreMiO study (3) used a validated screening tool to assess nutrition status in 1,952 treatment-naïve patients, 18 and older, with solid tumors, across 22 oncology centers in Italy. Fifty-one percent of patients were diagnosed with nutritional impairment, 9% were overtly malnourished, and 43% were at risk for malnutrition. All of this occurred prior to the start of treatment.

These findings are a wakeup call to the oncology community. Many patients are nutritionally compromised before a single drug is administered or a dose of radiation is given. Implementing nutrition care early means, ideally, prior to treatment or within the first 1-2 weeks of beginning therapy.

**Advocating for Better Access to Nutrition Care in All Outpatient Oncology Settings**

Dietitians need to engage other health care provider advocates. Once they understand how nutrition can support better medical care, physicians and nurses become interested in having these services available to all of their patients.

Share the literature on the connection between malnutrition and poor outcomes. Discuss with other HCPs health care providers the value of aggressive nutrition intervention as a way to reduce the risk of missed treatments, dose reductions, serious treatment toxicities and unplanned hospitalizations.

The survey results are just a first step toward reimbursement for outpatient oncology nutrition services and better access to care. The ON DPG is supporting ongoing work on a systematic review and malnutrition consensus paper with representatives from several professional cancer organizations. Along with the recent staffing survey results, these efforts will lay the foundation toward building a case and roadmap for RDN reimbursement.

**References**


Vitamin D Deficiency and its Association with Acute GVHD in Allogeneic Hematopoietic Cell Transplant

By Tara Coghlin-Dickson MS, RD, CSSD; Linda DuPuis-Rosen RN, BSN, OCN; D. Kathryn Tierney RN, PhD; Laura Johnston, MD; David Pickham, RN, PhD

Abstract
Vitamin D may be deficient in myeloablative allogeneic hematopoietic cell transplant (HCT) recipients and potentially associated with diagnosis of acute graft versus host disease (GVHD). We tested the prevalence of vitamin D deficiency within this cohort and its correlation with acute GVHD.

Methods: Fifty consecutive allogeneic HCT recipients between January 2012 and December 2013 were selected. Liquid chromatography-tandem mass spectrometry (LC-MS/MS) was used to determine 25-hydroxy vitamin D (25-OH vitamin D) levels at three different time-points.

Results: Of the 50 participants, 74% had vitamin D deficiency (median 20±8 ng/ml) pre-HCT, 86% had vitamin D deficiency at 30 days (median 16±8 ng/ml, p=.048), and remained deficient at 90 days (median 16±10 ng/ml). All 15 subjects with grade II-IV GVHD at 90 days had vitamin D deficiency (median 12±6 ng/ml, range 5-23ng/ml, p=.08).

Conclusion: We found vitamin D deficiency to be common pre HCT with significant decrease (p=.048) post HCT and all subjects with acute GVHD (grade II-IV) had vitamin D deficiency or vitamin D level < 25ng/ml. These data make a compelling argument for the development of standardized vitamin D monitoring and supplementation protocols, and the need to conduct large studies to elucidate the role of vitamin D relative to a potential correlation with acute GVHD.

Introduction
The impact and prevalence of vitamin D deficiency after hematopoietic cell transplant (HCT) is not well known. Symptoms of vitamin D deficiency are often vague and subtle, such as muscle weakness and pain. Chronic vitamin D deficiency can lead to significant health problems such as osteomalacia, osteoporosis, bone pain, muscle weakness, fatigue, and altered autoimmune regulation (1-5, 8). Risk factors for vitamin D deficiency in the HCT recipient include lack of exposure to sunlight post-transplant, sunscreen use, immunosuppressive medications, corticosteroids, altered gastrointestinal absorption, and poor dietary intake (6-8).

The role vitamin D plays in bone homeostasis is well documented, but recently the role of vitamin D in immune system function and regulation is being defined (9, 10, 14). It is now recognized that vitamin D receptors (VDRs) are expressed on all cells of the immune system (1, 9). Vitamin D’s immune modulating effects target immune cells such as monocytes, macrophages, dendritic cells, memory T cells and B cells which can affect innate and adaptive immune responses (10-13). Loss of immune modulation via vitamin D deficiency may play a role in immune tolerance and lead to an increased risk of GVHD (9, 14).

Joseph et al. (15) showed that repletion of vitamin D in vitro was sufficient to significantly reduce alloreactive T cell responses, suggesting potential to reduce the severity of GVHD. The pathophysiology of acute GVHD is complex and involves multiple immune cells.

The purpose of this retrospective study was to identify the prevalence of vitamin D deficiency pre HCT and within the first 90 days post myeloablative allogeneic HCT, and to identify a possible association between vitamin D deficiency and the development of acute GVHD.

Methods
The primary outcome variables were vitamin D levels within a cohort of myeloablative allogeneic HCT recipients and the incidence of acute GVHD. For analytical purposes vitamin D deficiency was defined as 25-OH vitamin D level of less than 25ng/ml (institution standard). Although oral supplementation of vitamin D was not given during the study period, 94% of the participants received nominal (400 IU) vitamin D supplementation in their IV nutrition for approximately two weeks, while the other 6% received it for approximately 10 days. Although we did not exclude these participants, we assessed the IV vitamin D supplementation as a modifier. For feasibility of our pilot study to assess vitamin D levels and a possible association with acute GVHD, 50 consecutive HCT recipients between January 2012 and December 2013 were selected.

All HCT recipients treated at our institution (Stanford Health Care) provide informed consent for participation in Institutional Review Board approved research projects.

Each of these 50 HCT recipients had cryopreserved bio-samples obtained pre-transplant and at approximately 30- and 90-days post HCT, for a total of 150 samples. The bio-samples were analyzed by liquid chromatography-tandem mass spectrometry (LC-MS/MS) for total 25-OH vitamin D. The primary outcome variables were total vitamin D level at three time points and the incidence of acute GVHD.

(Continued on next page)
Demographic and treatment variables of diagnosis, donor type, GVHD prophylaxis, disease status, TPN, albumin, age, BMI, gender, ethnicity and race (Table 1) were obtained from the transplant center database. Patient characteristics included diagnosis, disease status, type of donor, preparative regimen, use of total parenteral nutrition (TPN), length of inpatient stay, readmissions, GVHD prophylaxis, development of acute GVHD and GVHD therapy.

Descriptive analyses establishing vitamin D deficiency for each time point was completed. Chi square tests were conducted assessing for an association between vitamin D deficiency and development of acute GVHD. These analyses were compared at each of the three time points. An alpha of .05 was used to determine significance. All data analysis were performed using Predictive Analytics Software (IBM, PASW v 20, Armonk, New York).

**Results**

Men and women were equally represented within this study. Fifty percent of participants were Caucasian, 16% Asian, and 34% other. The most common diagnosis of 36% was acute myelogenous leukemia, followed by acute lymphoblastic leukemia (34%). Nearly all subjects received TPN (90%) during their first 90 days. Demographic and clinical characteristics are shown in Table 1.

**Vitamin D**

25-OH vitamin D level <25 ng/ml was found in 77% of the 150 samples which were comprised of samples at three different time points from 50 patients. Of the 50 HCT recipients, only three patients (6%) had normal vitamin D level at all 3 time points. Prior to transplant, 74% of the HCT recipients had vitamin D deficiency with a median level of 20±8 ng/ml (range 5 - 37ng/ml). Thirty days post-HCT, 86% of the recipients were vitamin D deficient with a median level of 16±8 ng/ml (range 4 - 42ng/ml), representing a significant decrease from pre-HCT levels, \( p=.048 \). Ninety days post-HCT vitamin D levels remained constant at a median 16±10 ng/ml (range 4 - 42ng/ml) in 86% of HCT recipients (Figure 1).

Fourteen participants or 30% were readmitted within the first 90 days post HCT. All patients requiring readmission had low levels of vitamin D at 30 days (median 13±7ng/ml).

### Table 1. Demographics and Clinical Characteristics are summarized.

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| Albumin (range)           | 1.7-  |
|                           | 4.1gm/dL |

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**Figure 1. Vitamin D Levels at Baseline, 30 Days, and 90 Days Post Transplant.**
None of the participants with normal vitamin D levels (3/3) required readmission. HCT recipients receiving corticosteroids for GVHD (See figure 3) prophylaxis (n = 12) had a median vitamin D level of 13±4 ng/ml (range 8 - 20ng/ml) at 30 days and 12±11 ng/ml (range 5 - 39 ng/ml) at 90 days, a decline from pre-HCT median levels of 18±7 ng/ml (p=.058) (Figure 2). Ninety percent of those in the study received TPN, containing up to 400 IU vitamin D/day for a median/mean of 15 days (range 0-127 days). With only a daily maintenance dose of vitamin D in their TPN, these patients remained vitamin D deficient at 90 days post-HCT.

**Acute GVHD**

Nearly half of all HCT recipients (46%, 23/50) within this cohort experienced acute GVHD of any grade (I-IV). Grade II-IV acute GVHD was observed in (30%, 15/50). Sites of acute GVHD in these patients included: ten skin only; one skin, gut and liver; two skin and liver; and two skin and gut.

**Vitamin D and Acute GVHD**

When analyzing subjects with all grades of acute GVHD (I-IV), there were no significant relationships to vitamin D level at 90 days (p=.9). The three recipients with normal vitamin D levels at all three time points had no GVHD. The distribution of vitamin D levels at 90 days by acute GVHD grade is shown in Figure 3. Whether clinically relevant acute GVHD (grades II-IV) is related to vitamin D level at 90 days was also tested. When removing those with grade I GVHD, all 15 subjects with grade II-IV had vitamin D deficiency (median 12±6 ng/ml, range 5-23ng/ml, p=.08).

**Discussion**

A high prevalence of vitamin D deficiency was identified in our cohort of 50 allogeneic HCT recipients. In addition to identifying vitamin D deficiency pre-HCT in a majority of recipients (74%), there was also a significant decline in vitamin D levels by day 30 post-HCT. Our findings are consistent with other studies. Joseph et al. (15) found that 70% of HCT recipients were vitamin D deficient on the day of transplant and Sproat et al. (16) showed that 90% were deficient < 90 days post-transplant. A recent large retrospective observational study looked at over 7000 HCT recipients (17), reported a 7 to 9 times greater incidence of bone fracture in the post HCT population compared to a normal population (8). The increased incidence of bone fractures strengthens the consideration to identify and treat vitamin D deficiency in this patient population.

In the current study, corticosteroid exposure was associated with low vitamin D levels. HCT recipients that received corticosteroids as GVHD prophylaxis had very low median levels of vitamin D 13.2 ± 4.4 ng/ml. Robien et al.
(18) assessed 95 HCT participants (mean age 32 years: range 2.7–72.2 years) and also reported a significant association between corticosteroid use and low vitamin D levels. Vitamin D levels in individuals receiving corticosteroids compared to those not receiving corticosteroids was 64.0 vs. 86.5 nmol/L, p=0.002).

Although our hypothesis was to identify a correlation between acute GVHD and vitamin D deficiency, no significant correlation between acute GVHD and vitamin D deficiency was identified. The lack of correlation may be true; however, the power of our study is limited by the small sample size. Nevertheless, our findings and those of others indicate that further exploration is warranted.

Rosenblatt et al. (14) has shown vitamin D deficiency may increase the risk of acute GVHD due to the loss of known immunomodulatory effects of vitamin D. This hypothesis is supported by Pakkala et al. (19) who investigated a novel vitamin D analog, MC1288, in the prevention of acute GVHD in a rat HCT model (n=18). They found that histological manifestations of GVHD were significantly lower (1.4 ± 0.5) in MC1288 treated rats than in the untreated rats (5.0 ± 1.6). Rats treated with MC1288 had a decrease in the clinical and histological signs of GVHD (19). Similarly, Ganetsky et al. (20) reported that vitamin D deficiency measured at 30 days post-HCT was associated with increased risk of grade II-IV cutaneous acute GVHD (p=0.05). Ganetsky et al. proposed that vitamin D may confer a protective effect against cutaneous acute GVHD via reduction in CC chemokine receptor 4 expression (20).

The concept of a protective effect may be best illustrated by Glotzbeker et al. (2) who reported a 63.8% incidence of chronic GVHD at two years post-transplant in HCT recipients with a vitamin D level <25ng/ml, compared to an incidence of 23.8% in recipients with higher vitamin D levels (>25ng/ml, p=0.009). Correcting vitamin D deficiency may mitigate a risk factor for the development of chronic GVHD. Most of the participants in our study received TPN with a nominal (up to 400 IU/day) vitamin D additive, however the level of vitamin D supplementation was not sufficient to increase vitamin D levels to a normal range.

Limitations
As a pilot study, the limited sample size was not adequate to develop a multivariate model for, and assessment of, the relationship between vitamin D levels and the development of acute GVHD. This study assessed allogeneic myeloablative recipients and excluded non-myeloablative protocols. The various GVHD prophylaxis regimens may have contributed to some of the variability in the findings.

Conclusion
In this study we found that nearly all (86%) participants were vitamin D deficient by 90 days post-HCT and 100% of recipients who developed grade II-IV GVHD were deficient. The results of this trial have prompted our BMT program to prospectively monitor vitamin D levels pre and post-HCT and provide standardized vitamin D supplementation with oral ergocalciferol for patients with 25-Hydroxy levels < 25 and oral cholecalciferol for patient with 25-hydroxy levels ≥/≤ 25. These data provide support for conducting a larger study that will help elucidate the role of vitamin D relative to immune function and its possible correlation with acute GVHD in allogeneic HCT recipients.

Acknowledgements
The authors thank the Stanford’s BMT team; Run Zhang Shi, Clinical Assistant Professor of Clinical Chemistry and Immunology at Stanford Clinical Labs and Patient Care Services, Stanford Health Care.

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1. Pakkala I, et al., MC1288, a vitamin D analog, prevents acute grade-versus-host disease in rat bone marrow transplantation. Bone Marrow Transplant. 2001;27(8);p863-867.
4. Rosenblatt J, et al., Immunomodulatory effects of vitamin D: implications for GVHD. Bone Marrow Transplant. 2010;45(9);p1463-1468.

Contributors needed
Oncology Nutrition Connection invites contributions from members on any of the following topics
• Disease-specific overviews
• Book reviews
• Summary of a published peer-reviewed article important to oncology practitioners
• Case-study presentation
• Performance improvement or quality improvement projects
• Summary of a recent oncology nutrition conference proceeding
• Student/intern submissions on topics of interest to oncology dietitians

No writing experience? No problem. Mentoring is available for first-time authors. If interested, please contact the editorial team.

Mridul Datta: Mridul900@gmail.com
Jennifer Lafferty: jennifer.lafferty@providence.org


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**Turmeric: Is the Golden Spice Still Golden in Breast Cancer?**

By Mridul Datta, PhD, RD, LD, FAND

**Abstract**

Curcumin, the biologically active constituent of turmeric, a spice commonly used in Asian cuisine, is gaining popularity for its preventive as well as some curative properties in many diseases including cancer. This review highlights the biochemical properties of curcumin and investigates curcumin’s role specifically in breast cancer.

**Introduction**

Turmeric powder, the yellow colored spice commonly used in Asian cuisine, is derived from the root of the turmeric (Curcuma longa) plant (1). Nutrients and constituents of interest in turmeric include: curcuminoids, volatile essential oils 3-7%, fiber 2-7% minerals 3-7%, protein 6-8%, fat 5-10%, moisture 6-13% and carbohydrates 60-70% (2). There are three main types of curcuminoids found in turmeric: curcumin I (1,7-bis-4-hydroxy-3-methoxyphenyl-hepta-1,6-diene-3,5-dione), demethoxycurcumin II (1,4-hydroxy-3-methoxyphenyl-7,4 hydroxyphenyl-hepta-1,6-diene-3,5-dione), and bisdemethoxycurcumin III (1,7-bis-4-hydroxyphenyl-hepta-1,6-diene-3,5-dione). Turmeric’s curcuminoid content varies between 3-5% of dry weight and is dependent on geographical and growth conditions (3).
Commercial curcumin, however, may contain approximately 70-75% curcumin I, 20% curcumin II and 5% curcumin III (4). Despite the presence of several phytochemicals and polysaccharides, turmeric’s therapeutic properties have been ascribed to its active polyphenolic constituent, curcumin.

Curcuminoids (or curcumin) are lipophilic in nature and easily permeate the cell membrane. They are extremely sensitive to light and stable at high temperatures, but extremely unstable at pH > 5, and increasing the pH value of solutions, significantly increases the rate of degradation (1, 5).

According to the World Health Organization’s Joint FAO/WHO Expert Committee on Food Additives, allowable daily intake of curcumin is estimated to be 0-3 mg/Kg body weight (6). Curcumin has poor bioavailability in both tissues and plasma, which may be due to poor absorption, rapid metabolism and systemic elimination (5, 7). To improve bioavailability, various approaches such as adjuvants, liposomal curcumin, curcumin nanoparticles, curcumin phospholipid complexes etc. are being investigated (3, 7). Caution should be used with curcumin supplements since liver toxicities have been reported from curcumin additives, which may significantly increase bioavailability of curcumin (8). Main metabolites of curcumin include tetrahydrocurcumin, hexahydrocurcumin, hexahydrocurcuminal, curcumin sulfate and curcumin glucuronide (1). Schneider et al. offers a comprehensive review of the metabolism and breakdown of curcumin (9).

Curcumin is used both as a topical agent and for oral treatment of simple as well as complex medical conditions. It has been used to treat stress, headaches, fever, gastrointestinal disorders (such as dyspepsia, abdominal pain, Crohn’s disease and ulcerative colitis, diarrhea, flatulence, abdominal bloating, Helicobacter pylori, peptic ulcers, irritable bowel syndrome, etc.) and even cancer (7, 10).

Curcumin and Cancer

In addition to its antioxidant and anti-inflammatory activity, curcumin may inhibit the initiation, progression, invasion and metastasis of cancer cells. Curcumin strongly inhibits the activity of NF-κB and related pathways to induce cellular apoptosis (1). In addition to NF-κB, other molecular targets of curcumin include inflammatory cytokines, kinases, enzymes, transcription factors, adhesion molecules, apoptotic regulators, receptors and growth factors (5, 7). Curcumin is a powerful epigenetic regulator via inhibition of DNA methyltransferases, and regulation of histone modifications (5, 7). Because of these biological activities, curcumin is an attractive compound in oncology prevention and care. This article reviews curcumin’s role in the prevention and treatment of breast cancer.

Curcumin and Breast Cancer

Studies investigating curcumin’s role in cancer are primarily in vitro and preclinical studies. A search for the word “turmeric” yielded 160 clinical trials and “curcumin” yielded 216 clinical trials registered on Clinicaltrials.gov. Combining “curcumin” and “breast” identified two additional trials. Trials are being conducted to understand the pharmacokinetics and safety with different delivery systems and to alleviate side effects and improve quality of life in populations ranging from Gulf War Syndrome to periodontics to cancer (head and neck, colon, rectum, pancreas, multiple myeloma, lymphoma, osteosarcoma, glioblastoma, prostate, cervix, endometrium, uterus, and breast). Only 12 clinical trials focused exclusively on breast cancer and eight of these are being conducted in the U.S. (Table 1). These studies are investigating curcumin’s effect on chemotherapy-induced peripheral neuropathy, radiation dermatitis, and reducing joint pain from aromatase inhibitors in breast cancer. Two trials investigated the use of a topical product and one used IV administration (300 mg) of curcumin, whereas the rest of the trials administered various amounts of curcumin ranging from 1-8 gm of curcumin orally.

In breast cancer, curcumin’s anticancer effects are observed through its impact on proliferation, estrogen receptor and human epidermal growth factor receptor-2 pathways, regulation of apoptosis and cell-phase related genes and microRNA (11). Some of the research studies in breast cancer are summarized below:

Ramachandran et al. (12) investigated the cytotoxic, apoptotic, and gene regulatory effects of 0, 10, 25, 50, 75, 100, 150 and 200 µg/ml of both turmeric and curcumin in the MCF-7 hormone breast cancer cell line and MCF-10A human mammary epithelial cells. MCF-7 cells were more sensitive to turmeric and curcumin and demonstrated a higher apoptosis, compared to MCF-10A cells, by regulating multiple signaling pathways. Both 25 µg/ml and 50 µg/ml doses of curcumin upregulated 22 genes >3 fold (HIAP1, CRYF1, TRAF6, CASP1, CASP2, CASP3, CASP4, HPRT, GADD45, MCL-1, NIP1, BCL2L2, TRAP3, GSTP1, DAXX, PIG11, UBC, PIG3, PCNA, CDC10, JNK1 and RBP2) and downregulated 17 genes <3 fold (TRAIL, TNFR, AP13, IGFBP3, SARP3, PKB, IGFBP, CASP7, CASP9, TNFSF6, TRICK2A, CAS, TRAIL-R2, RATS1, hTRIP, TNFβ and TNFRSF5) (12).

Liu et al. (13) investigated the effect of curcumin on cell inhibition mechanisms (NF-κB, cell cycle regulatory proteins and matrix metalloproteinases (MMP)) in breast cancer cell lines (MDA-MB-231 and BT-483). The anti-proliferation effect of curcumin on MDA-MB-231 and BT-483 cells was observed in a time- and dose-dependent manner. NF-κB was downregulated and the expression of MMP1 mRNA was decreased significantly in the curcumin group in cell lines compared with the control group (13).

Fang et al. (14) investigated the proteins involved in curcumin’s anticancer activity in human breast cancer cell line MCF-7. Fang et al. discovered that curcumin up-regulated (3-PGDH, ERP29, and platelet-activating factor acetylhydrolase IB subunit beta) and down-regulated (TDP-43, SF2/ASF and eIF3i) many of the proteins that positively contribute to curcumin’s anticancer activity in MCF-7 cells (14).

Park et al. (15) investigated the inhibitory effects of aromatic-turmerone (found in (Continued on page 12)
Table 1. Registered clinical trials investigating curcumin in breast cancer*

<table>
<thead>
<tr>
<th>Study title</th>
<th>Study details</th>
<th>n</th>
<th>Interventions</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &quot;window trial&quot; on curcumin for invasive breast cancer primary tumors</td>
<td>This single arm study is investigating whether administration of 500 mg oral of Curcuma longa administered twice-daily extract causes biological changes related to apoptosis and cell proliferation in primary tumors of breast cancer patients.</td>
<td>20</td>
<td>Curcumin</td>
<td>recruiting</td>
</tr>
<tr>
<td>Curcumin in reducing joint pain in breast cancer survivors with aromatase inhibitor-induced joint disease</td>
<td>This randomized trial is investigating how well curcumin nanoemulsion administered twice daily for three months works in reducing joint pain in patients who are breast cancer survivors and have joint disease caused by treatment with aromatase inhibitors.</td>
<td>40</td>
<td>Curcumin nanoemulsion vs placebo</td>
<td>recruiting</td>
</tr>
<tr>
<td>Chemotherapy-induced peripheral neuropathy-essential oil intervention</td>
<td>This randomized trial will evaluate an oil blend (10% dilution of Curcuma longa, Piper nigrum, Pelargonium asperum, Zingiber officinale, Mentha x piperita, and Rosmarinus officinalis ct. cineole in Simmondsia chinensis) for the reduction in chemotherapy-induced peripheral neuropathy in breast cancer.</td>
<td>40</td>
<td>Essential oil intervention vs placebo</td>
<td>recruiting</td>
</tr>
<tr>
<td>Effect of preoperative curcumin in breast cancer patients</td>
<td>This randomized trial is investigating the effect of curcumin administered 4000 mg twice daily (2-4 weeks prior to their surgery) vs placebo in Breast Cancer Patients. (Malaysia)</td>
<td>30</td>
<td>Curcumin vs placebo</td>
<td>Active, but not recruiting</td>
</tr>
<tr>
<td>Disposition of dietary polyphenols and methylxanthines in mammary tissues from breast cancer patients</td>
<td>This randomized trial is characterizing the metabolic profile of dietary polyphenols in normal and malignant glandular breast tissues from newly diagnosed breast cancer patients, who consumed a polyphenol-rich dietary supplement containing 37 different phenolics and 2 methylxanthines (theobromine and caffeine) from the diagnosis to the surgery. (Spain)</td>
<td>40</td>
<td>Polyphenol supplement</td>
<td>Active, but not recruiting</td>
</tr>
<tr>
<td>Pilot study of curcumin for women with obesity and high risk for breast cancer</td>
<td>This randomized pilot clinical trial studied a nanoemulsion formulation of curcumin (50 mg twice a day for 3 months) in reducing inflammatory changes in breast tissue of obese women at high risk for breast cancer.</td>
<td>29</td>
<td>Curcumin nanoemulsion</td>
<td>complete</td>
</tr>
<tr>
<td>Curcumin for the prevention of radiation-induced dermatitis in breast cancer patients</td>
<td>This randomized phase 2 clinical trial investigated if 2000 mg curcumin thrice daily can prevent or alleviate radiation-induced skin reactions in cancer patients receiving radiotherapy. Additionally, investigators sought to determine if skin pigmentation, pain and psychophysiological factors, can predict the severity of radiation-induced dermatitis.</td>
<td>35</td>
<td>Curcumin C3 complex vs placebo</td>
<td>complete</td>
</tr>
<tr>
<td>Oral curcumin for radiation dermatitis</td>
<td>The purpose of this randomized, phase 2/3 trial was to determine whether 2 gm thrice daily curcumin can prevent or reduce the severity of skin reactions (dermatitis) caused by radiation therapy.</td>
<td>686</td>
<td>Curcumin C3 complex vs placebo</td>
<td>complete</td>
</tr>
<tr>
<td>Prophylactic topical agents in reducing radiation induced dermatitis in patients with non-inflammatory breast cancer</td>
<td>This randomized pilot phase 2 trial evaluated the effectiveness of a curcumin based gel applied topically thrice daily (from first day of treatment to 1 week after completion of treatment) in reducing radiation-induced dermatitis in patients with non-inflammatory breast cancer or breast cancer in situ.</td>
<td>191</td>
<td>Curcumin based gel (HPR Plus™) vs placebo</td>
<td>complete</td>
</tr>
<tr>
<td>“Curcumin” in combination with chemotherapy in advanced breast cancer</td>
<td>The aim of this randomized, double-blind, placebo-controlled phase 2 trial was to assess the benefits of treatment with 300 mg intravenous Curcumin® (CUC-01) vs placebo, in combination with paclitaxel chemotherapy, and to estimate the risk of adverse events in patients with locally advanced and metastatic breast cancer. (Armenia)</td>
<td>150</td>
<td>(IV curcumin vs placebo) + paclitaxel</td>
<td>complete</td>
</tr>
<tr>
<td>Phase II study of curcumin vs placebo for chemotherapy-treated breast cancer patients undergoing radiotherapy</td>
<td>This randomized trial investigated if 500 mg curcumin administered twice daily reduces NF-κB DNA binding and ultimately its downstream mediator IL-6 in patients receiving XRT for their breast cancer after having completed chemotherapy.</td>
<td>30</td>
<td>Curcumin (Meriva) vs placebo</td>
<td>complete</td>
</tr>
<tr>
<td>Docetaxel with or without a phytochemical in treating patients with breast cancer</td>
<td>This randomized phase 2 trial investigated the effect of docetaxel together with curcumin or docetaxel alone as first- or second-line therapy in treating patients with breast cancer. (France)</td>
<td>42</td>
<td>Curcumin Docetaxel</td>
<td>Terminated secondary to “futility in view of the results of the anticipated analysis”</td>
</tr>
</tbody>
</table>

*Unless specified, trials are conducted in the U.S. Results reported, when available.
turmeric) on expression and enzymatic activity levels of 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced MMP-9 and cyclooxygenase-2 (COX-2) in breast cancer cells. Their results indicate that by blocking NF-kB, PI3K/Akt, and ERK1/2 signaling, aromatic turmerone suppressed the TPA-induced up-regulation of MMP-9 and COX-2 expression and also inhibited TPA-induced invasion, migration, and colony formation in human breast cancer cells (15).

Kim et al. (16) investigated the inhibitory effect of curcumin on cell invasion and 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced MMP-9 expression and the molecular mechanisms involved in MCF-7 cells. Curcumin inhibited TPA-induced MMP-9 expression and cell invasion by suppressing PKCa, MAPK, NF-kB and AP-1 activation in MCF-7 cells (16).

Wright et al. (17) investigated the pharmacodynamic effects of turmeric extracts and structurally related metabolites of curcuminoids (vanillin, ferulic acid and tetrahydrocurcuminoids) on human triple negative breast cancer cell growth and tumor cell secretion of parathyroid hormone-related protein (PTHrP), an important driver of cancer to bone metastasis. Polyphenolic curcuminoids in the turmeric extract demonstrated anti-breast cancer activity. Curcumin metabolites however, were not strong inhibitors of breast cancer cell growth or PTHrP secretion, indicating the importance of the structural and biological importance of curcuminoids and that the biological activity of all parent compounds and metabolites do not have the same anti-cancer effects (17).

Coker-Gurkan et al. (18) investigated the role of NF-kB signaling and miR-182-96-183 cluster expression on autocrine growth hormone mediated curcumin resistance in breast cancer cells. Curcumin treatment for 48 hours prevented the autocrine growth hormone mediated miR-182-96-183 cluster expression, epithelial mesenchymal transition activation by inhibiting NF-kB signaling and induced apoptotic cell death by modulating Bcl-2 family members (anti-apoptotic proteins Bcl-2, Bcl-xL, Mcl-1) were downregulated and pro-apoptotic proteins Bax and PUMA were upregulated) in T47D breast cancer cells (18).

Calaf and Roy (19) investigated the expression of metastatic genes in a radiation- and estrogen-induced breast cancer cell model and the effect of curcumin on metastatic genes in breast cancer. The researchers exposed immortalized breast cancer epithelial cell line MCF-10F to alpha-particle radiation (60 cGy) in the presence or absence of 17β-estradiol and treated with 30 μM curcumin for 48 hours. Tumor2 cell line was used as a control. Curcumin upregulated TGF-α, TGFβ1, e-cadherin, c-myc and CD44 expression in MCF-10F cells but downregulated them in Tumor2 cell line, indicating that curcumin positively affected metastatic genes in an advanced breast cancer model. Although the exact mechanisms are unknown, researchers are optimistic about the potential of curcumin in advanced breast cancer. Furthermore, this research group also investigated the biological processes that may be altered during breast carcinogenesis in the same cell line model (20). Researchers found that in the presence of curcumin, the base excision repair pathway protein, Polyadenosine diphosphate ribose polymerase-1 (PARP-1) or phosphorylated histone H2AX (γ-H2AX) provide cellular protection against estrogen and radiation-induced DNA damage (20).

Waseem and Parvez (21) evaluated cisplatin related damage and its mitigation by curcumin. Cisplatin caused significant induction of brain and liver mitochondrial lipid peroxidation and brain mitochondrial protein carbonyl content (biomarkers of oxidative stress), which were attenuated by curcumin. Thus, curcumin can attenuate cisplatin induced mitochondrial neuro and hepatotoxicity and should be investigated as a potential safe and effective approach to attenuate cisplatin related adverse effects (21).

Results of clinical trials to assess the benefit of oral and topical curcumin to prevent/reduce radiation-induced dermatitis, demonstrated no benefits (Table 1). Detailed information on the pharmacokinetics and drug interactions of curcumin can be found in Table 2.

Herb-Drug interactions

Although curcuminoids are “generally regarded as safe” by the FDA (22), curcumin has the potential for herb-drug interactions. There is some concern that turmeric or rather its active constituent curcumin may reduce the activity of alkylating agents such as cyclophosphamide, antitumor antibiotics such as doxorubicin, chemotherapeutic drugs. Cytochrome P450 (CYP) enzymes are critical drug-metabolizing enzymes, and can be impacted with concurrent use of drugs and phytonutrients (23). Curcuminoids may elevate or inhibit the activity of several CYP subtypes such as CYP1 (CYP1A1, CYP1A2, CYP1B1), CYP2 (CYP2A6, CYP2B6, CYP2C2, CYP2C19, CYP2D6, CYP2E1), CYP3 (CYP3A, CYP3A4) and may lead to the increase or decrease of drug and curcuminoid serum levels (23). For example, concurrent administration of curcumin with either paclitaxel or docetaxel and increased bioavailability and tumor tissue accumulation of the drugs in rats (CYP3A2). The response with docetaxel was significant enough for the authors to suggest that since this adverse effect may also be observed in humans, dose adjustment of docetaxel with concurrent use of curcumin should be undertaken (23). However, the phase 2 trial (Table 1) investigating docetaxel with or without curcumin in treating patients with breast cancer was terminated secondary to “futility in view of the results of the anticipated analysis.”

Increased bioavailability was also observed with Phospho-sulindac, Tamoxifen (and possibly Raloxifene, due to similar metabolic pathway as Tamoxifen) and Etoposide. This may, however, be advantageous in the oncology patients to reduce side effects and potentially requiring lower doses of chemotherapeutic drugs with concurrent use of curcumin (23). These predictions need to be clinically evaluated before making practice recommendations. Curcumin affects other classifications of drugs such as cardiovascular, anticoagulants, antibiotics, antidepressants, antihistamines, but a detailed review of all classification of drugs is beyond the scope of this review.
From the Natural Medicine database (10), curcumin’s interaction with several drugs (Table 2) indicates a potential for minimal side effects to life-threatening adverse events. These interactions were tested primarily in cell and animal studies. Caution should be used when interpreting these data for relevance to humans.

**Conclusion**

Turmeric sales in the U.S. are projected to increase from $163 million in 2016 to $433 million in 2020 (24). Turmeric or curcumin is believed to be a panacea for every health condition from headache to cancer. Review by Nelson et al. (2) raises significant concerns whether the therapeutic benefits of turmeric should be ascribed to curcumin, due to its poor pharmacokinetics and chemical instability and multiple means of interfering with assays. Curcumin has extremely poor bioavailability, despite ingestion of large doses, although researchers are trying to improve bioavailability by incorporating nanoparticles and adjuvants. Benefits of these in improving bioavailability remains to be validated. Nelson et al. (2) very nicely highlight the deficiencies in the few clinical trials with curcumin that have been published. Detailed review of these trials is beyond the scope of this manuscript. No benefits of oral or topical curcumin in preventing radiation-induced dermatitis were observed in recent clinical trial in women with breast cancer. However, since most of the evidence on the efficacy of curcumin comes from in vitro studies and few well-controlled clinical trials exist, curcumin supplements should be used with caution, particularly during chemotherapy. However, no restrictions exist for consumption of dietary turmeric. Other treatments for radiation-induced dermatitis, should be investigated.

**References**


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The International Dysphagia Diet Standardisation Initiative (IDDSI): Raising Global Awareness

By Peter Lam, RD and Julie Cichero, SLP
Co-Chairs International Dysphagia Diet Standardization Initiative (IDDSI), on behalf of the IDDSI Board of Directors

Introduction
Eating and drinking are some of our most basic human needs and the way we connect with each other. Dysphagia affects about 8% of the world’s populations and leaves its mark on every age group (1). The International Dysphagia Diet Standardisation Initiative (IDDSI) was developed with the overarching theme of safety for people with swallowing difficulties. On 31 January 2017, the Academy of Nutrition and Dietetics and the American Speech-Language Hearing Association together announced their support of IDDSI to assist people who suffer from Swallowing disorders. IDDSI welcomes the generous and enthusiastic support from around the world. More than 20 countries are actively engaged in IDDSI activities, including raising awareness of the framework and preparing for implementation. Officially published in 2017 (2), IDDSI has developed global standardized terminology and definitions for texture modified foods and thickened liquids to improve the safety and care of individuals with dysphagia of all ages, in all care settings and all cultures. One language, so that no matter where you are in the world, as a person with dysphagia, as a care-giver, or as a clinician, you can reliably communicate your needs to find food and liquid textures that are safe to eat or drink.

Benefits of Standardized Terminology
Since 2002, a number of countries have recognized the benefits of dysphagia diet standardization, and developed their own national descriptors (1, 3). At a national level, this helps to reduce confusion between care settings and provides a common terminology for those who care for people with dysphagia. However, with rapid technology and communication development, our world is fast becoming a global village. People are more mobile and travel is widely accessible. A common international language for texture modified food and thickened liquids allows us to communicate across the globe and advance research in dysphagia. Additionally, adaption of national terminology in the past has been inconsistent, or relied on measurement tools that are not accessible to clinicians. These elements defeat the purpose of having common terms/definitions; resulting in confusion and misinterpretation that affects patient safety. A common terminology with accessible testing methods will also allow dysphagia research to take a considerable step forward. The ability to consistently and reliably describe foods and liquids used for assessment and treatment of dysphagia means that research conducted in the USA will be applicable to people in Europe, South Africa, Australia, China, Japan, etc. and vice versa. A collaborative approach to dysphagia treatment conducted throughout the world by way of a common language helps those most vulnerable —- people with swallowing difficulties.

Evidence-Based, Best Practice Design of the IDDSI Framework
The IDDSI Framework was developed following key elements of global best practice, evidence-based guideline development processes common to the World Health Organization (WHO), the Scottish Intercollegiate Guidelines Network (NICE), the Council of Europe, the National Health and Medical Research Council of Australia (NHMRC) and the National Institute of Health and Clinical Excellence in the UK (NICE) (2). These elements included:
• establishment of a multidisciplinary guideline development group
• involvement of consumers
• clear identification of clinical issues
• systematic review and appraisal of quality literature (4)
• a process for drafting the recommendation of the multidisciplinary group
• consultation with others beyond the multidisciplinary framework development group

More than 3,000 participants from 57 countries provided comment on the draft framework before it was finalized and published (1).
Key Features of the IDDSI Framework

The IDDSI Framework (See Figure 1) places liquids and foods on a single continuum. There is an overlap at Levels 3 and 4. The overlap zone denotes that texture and flow properties of Liquidized foods (Level 3) are very similar or equivalent to Moderately Thick liquids. Similarly, the texture and properties of Pureed food (Level 4) is very similar, or equivalent to Extremely Thick liquids.

‘Transitional’ foods’ are a group noted on the food side of the pyramid and denote foods commonly used in pediatric treatment or for rehabilitation treatment of chewing skills. They are foods that start as one texture, and with moisture or a change in temperature, rapidly change to a different texture that requires minimal chewing (e.g. potato crisps, wafers, cheese puffs).

IDDSI has three ways of identifying levels including label, number and colour to enhance communication. IDDSI recommends that at least two of these methods are used to identify IDDSI levels. Specific colours have been chosen to minimise barriers associated with colour blindness. When ordering diets with the IDDSI Framework, patients require a prescription for food and for the liquids according to their clinical needs. For example, patients may be recommended to have Soft & Bite-sized (Level 6) plus Thin liquids (Level 0) liquids, or Pureed food (Level 4) with Mildly Thick liquids (Level 2). Each patient should have two levels noted to meet both food and liquid menu requirements. Standard abbreviations are being evaluated to facilitate practical order transcriptions in electronic menu ordering systems and will be released via the IDDSI website (www.iddsi.org).

One of the innovations of the IDDSI Framework is the development of testing methods that can be applied in any setting. The ability to check liquid thickness at a cafe after adding thickener, or spot-checking a meal tray that has arrived at bedside is now possible. Particle sizes and texture recommendations for each level have been clearly identified to minimize choking risk.

Forks can be used to assess particle size and food softness, while spoons assist with determining cohesive and adhesive food properties that affect swallowing safety. The testing methods allow for people to check the food on the plate, including the gravy or sauce to be sure that it is as the clinicians intended for safe swallowing. The IDDSI Flow Test allows for liquids to be quickly and easily classified, giving confidence that thick liquids will be consistent from batch to batch of kitchen produced and factory produced items. Further, the IDDSI Flow Test also allows clinicians to determine the thickness of soups, gravies, sauces and liquid nutritional supplements.

IDDSI Flow Test

The IDDSI Flow Test uses a 10mL slip tip syringe with barrel length 61.5mm from the zero line to the 10mL line (see Figure 2). The 10mL syringe is filled to the 10mL line with a liquid and then allowed to flow for 10 seconds. At the end of the 10 seconds of flow, the remaining volume is recorded and is compared to the IDDSI Flow Test information for categorization of thickness level. Deceptively simple, the IDDSI Flow Test has its background in engineering. It is similar to the Posthumus Funnel used to assess liquid thickness in the dairy industry and the Marsh Funnel used by engineers to evaluate complex liquids and semisolids (e.g. concrete mixtures). Measurements using these funnels provide good correlation with measurements of liquid viscosity (5, 6, 7). The science behind funnel and pipette testing is well established in the engineering literature. Many of the liquid testing methods commonly used by clinicians have originated from engineering tests. For example the Line Spread Test (LST) is based on the slump test used for concrete. Liquid assessments using funnels of certain dimensions have been found to have stronger correlations with sensory assessment (in mouth experience) than the Line Spread Test (7). Researchers have found that funnel and viscometer tests are more accurate and sensitive to detecting changes in liquid viscosity than the LST (5, 8). More recent studies have compared the Bostwick Consistometer, LST and IDDSI Flow Test for measurement of liquid thickness. Hadde (9) found that measures using the Bostwick and LST were affected by factors other than viscosity (e.g. yield stress and surface tension), whereas the IDDSI Flow Test was not affected by these factors. The impacts of viscosity, yield and temperature on fluid flow are also considered.
stress, surface tension and other textural properties on swallow physiology are yet to be clearly understood, but research is ongoing internationally and published literature on the IDDSI Flow Test will be made available as it comes to hand.

**IDDSI Food Testing**

The IDDSI Systematic review demonstrated that the food properties of hardness, cohesiveness and slipperiness were important factors for consideration (4). Autopsy and choking literature further shows that food shape and food size are also relevant factors to reduce choking risk (1, 2). Consequently, food texture properties as well as size and shape of food items need to be assessed. The IDDSI Testing Methods provide descriptions of each food level and accompanying tests. More than one test may be needed to determine which level a food fits into. The property and behavior of texture modified foods will vary depending on factors such as how they have been prepared, ingredients, moisture content, starch content, fat content, temperature, holding time, etc. For this reason it is always better to evaluate the food texture at the point in time where it will be served to the client. Scrambled eggs prepared and eaten while still warm are of a different consistency and texture to those that are cold. The entire food texture profile is important and clinicians should be guided by a combination of the detailed descriptions as well as the testing methods to determine what level a food is to ensure it is safe to be given to the client as it appears on the plate, at the point of service. Food particle sizes and texture requirements are based on available national published literature including the National Dysphagia Diet (NDD), as well as physiologic rationales. For example, Soft & Bite-Sized (Level 6) food pieces are described as 15mm x 15mm (about ⅛ inch) for adults and 8mm piece for pediatric (1). These sizes were chosen based on tracheal diameter, so that if food that is accidentally inhaled it will pass through, rather than occlude the airway. Further the food is described as soft, tender and moist throughout with no separate thin liquids. To test whether the food meets these requirements, take a bite-sized piece of food (15mm x 15mm) and press the sample with a standard dinner fork, applying enough pressure so that the thumb nail blanches to white. The sample should squash and not return to its original shape when the fork is removed. The pressure applied to make the thumb nail blanch has been measured at 17 kilopascals which is consistent with tongue force used during swallowing (10). Kilopascals (kPa) are a unit of force measurement with 6.89 kPa equivalent to 1 pound per square inch (psi). IDDSI recognizes that not all countries routinely use forks and so equivalent chopstick tests and even finger pressure tests can be used.

For Minced & Moist (Level 5), a 4mm lump size (about ¼ inch) has been recommended for adults and 2mm lump size for pediatrics, with all particles to be soft and moist enough to break down with tongue force alone and with no separate thin liquids. This texture is designed to mimic that of a chewed bolus. Research shows particle sizes of a chewed bolus to be approximately 2-4mm and bound together in moist, slippery saliva to facilitate swallowing. As with a chewed bolus, food particle sizes may be uneven, but should have a diameter less than 4mm. The gaps between the tines of a standard dinner fork coincidentally measure 4mm and can be used as a quick reference check for particle size and to further mash food down if the pieces are too large. The small soft pieces should be soft enough that tongue force alone can break them down further. The food should be moist, not sticky. Note, the entire texture profile is important; not a pass/fail focus only one parameter. For example, consider a macaroni and cheese dish. The pasta has been lightly blitzed with a food processor to meet the 4mm particle size lump requirement, however the cheese sauce is sticky, adhering to itself and the spoon. It is also sticky to touch. Although the dish passes the particle size requirement for Minced & Moist (Level 5), it fails overall because of the stickiness. Sticky items are a choking risk because they adhere to the throat and airway, and resist being expelled.

For Pureed food (Level 4), the food should be smooth, cohesive, moist, not sticky and without lumps. It should not be firm enough to pick up and eat as finger food or leave excessive residue when tilted off a spoon, as this degree of solidification and stickiness may cause residue to collect in the pharynx and/or airway obstruction. Further detailed descriptions and testing methods can be found on the IDDSI website (www.iddsi.org).

**Towards Implementation**

While standardization of terminology is important, IDDSI recognizes that customization of the framework to meet cultural and local needs is also important. The ability to classify Oatmeal as opposed to Porridge, and Cookies vs. English Biscuits is also important. Testing methods allow clinicians and caregivers alike to determine what category a specific food or liquid fits into. It is important to understand that there is no requirement for facilities to provide every IDDSI Level. For example, Slightly Thick liquids (Level 1) is most commonly used by pediatric clinicians to manage aspiration in infants and has also been used by clinicians working with adults in palliative care. However, if that level is not usually used in your workplace, there is no need to include it. Evaluate label/terms with existing foods and drinks according to the IDDSI testing methods and change to the IDDSI labels. For example some facilities may currently provide Thin (Level 0); Mildly thick (Level 2; similar to NDD-Nectar); Moderately Thick (Level 3; similar to NDD-Honey); Extremely thick (Level 4; similar to NDD Spoon-Thick); Puree (Level 4; similar to NDD-Dysphagia Puree); Minced & Moist (Level 5; some similarities to NDD Dysphagia Mechanically altered); Soft & Bite-sized (Level 6; some similarities to NDD Dysphagia advanced), being careful to look for changes in particle size and texture descriptions. For example, the particle size for Minced & Moist (Level 5) is smaller than the NDD Mechanically Altered particle size. In addition, please note there are different particle sizes for adult and pediatric populations for Soft & Bite-sized (Level 6) and Minced & Moist (Level 5) as the IDDSI Framework is relevant for individuals of all ages. A currency converter between the NDD terminology and IDDSI terminology is shown in Table 1.

(Continued on next page)
Additional differences include “no separate thin liquids” and most bread products (in their usual presentation) are not tolerated. The IDDSI detailed descriptions and testing methods provide guidance on acceptable food textures. Translations are complete for French (both Europe and Canada) and are under review for Norwegian, Italian, Swahili, Spanish, Portuguese, Chinese and Japanese, with more planned.

Raising global awareness of IDDSI is currently underway, with resources to assist in planning and implementation available from the IDDSI website (www.iddsi.org). Planning has begun for implementation in the USA, with a 2-3 year period anticipated. Advice from pilot sites around the world, including Kempen, Germany, where the first pilot implementation occurred, demonstrates the importance and benefit from multi-professional collaboration (11). Gathering together registered dietitian nutritionists, speech-language pathologists, chefs, kitchen and meal service staff, and nurses and doctors to work together towards implementation has demonstrated positive outcomes. Industry (e.g. food and beverage industry, thicker and texture modified food industry) is also strongly supporting the initiative and developing transitional labels to assist in education regarding the change to terminology. During this time of preparation and implementation, the IDDSI website (www.iddsi.org) houses the most up-to-date resources, information and Open Access peer-reviewed journal publications documenting the IDDSI framework.

References


### Table 1. Comparison between NDD Diet names and IDDSI Framework labels

<table>
<thead>
<tr>
<th>NDD Name</th>
<th>Similar to IDDSI Diet Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDD Level 3: Advanced &lt;25mm</td>
<td>Soft &amp; Bite-Sized (Level 6): 15mm x 15mm (Adult particle size)</td>
</tr>
<tr>
<td></td>
<td>8mm x 8mm (pediatric particle size)</td>
</tr>
<tr>
<td>NDD Level 2: Mechanically altered 6mm particle size</td>
<td>Minced &amp; Moist (Level 5): 4mm (Adult particle size)</td>
</tr>
<tr>
<td></td>
<td>2mm (pediatric particle size)</td>
</tr>
<tr>
<td>NDD Level 1: Pureed</td>
<td>Pureed (Level 4)</td>
</tr>
<tr>
<td>Pudding or Spoon Thick</td>
<td>Extremely Thick (Level 4)</td>
</tr>
<tr>
<td>Honey Thick Liquid</td>
<td>Liquidised (Level 3)</td>
</tr>
<tr>
<td></td>
<td>Moderately Thick (Level 3)</td>
</tr>
<tr>
<td>Nectar Thick Liquid</td>
<td>Mildly Thick (Level 2)</td>
</tr>
<tr>
<td>No NDD Level</td>
<td>Slightly Thick (Level 1)</td>
</tr>
<tr>
<td></td>
<td>Thin (Level 0)</td>
</tr>
</tbody>
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