Effective Feedback in the Education of Health Professionals

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Abstract

Clinical educators of health professions training programs are often underprepared for their teaching roles due to a lack of formal training in educational methodology. The emphasis on competency-based education in the health professions has led to a re-evaluation of the standards for a competent clinical teacher. Feedback is an important aspect of nearly all learning theories. The effectiveness of feedback relates to its double-barreled approach that focuses on both the cognitive and motivational aspects of learning. Feedback should be related to progression toward competency to promote self-motivated learning. Both the tone and perceived intention of feedback affect how a learner incorporates and uses such information. Descriptive feedback on the performance of tasks is the most beneficial. Characteristics of effective feedback include the creation of a receptive environment, focus on behaviors, specificity, comparison to a standard of competency, timeliness, ensuring an appropriate amount so as to not overwhelm the learner, and encouragement of self-directed learning. Faculty development interventions targeted toward learning to provide appropriate feedback are critical in improving the educational process.

Introduction

The purpose of health professions education is to create competent practitioners. Traditionally, the process of educating practitioners in medicine was an apprenticeship with one-on-one supervision, and clinicians were assumed to be both competent practitioners and educators following completion of appropriate apprenticeship training (1). Unfortunately, although clinical educators often receive substantial education in their clinical field, most lack formal training in education. In the field of nutrition and dietetics, preceptors often have minimal exposure to education on teaching skills, particularly those related to student assessment and evaluation (2,3). Subsequently, underprepared faculty often engage in ad hoc training to improve their skills after assuming teaching roles (4).

In recent years, the shift in emphasis to behaviorally based training in medicine has resulted in competency-based education for most health professions training programs (5). In essence, competency-based education programs require that learners demonstrate their abilities via a measurable approach with a reasonable degree of consistency serving as proof of their competency to practice in their chosen field. These programs focus on what clinicians should be able to do rather than simply on their completion of a specific period of training. This paradigm change has led health professions education stakeholders to re-evaluate their standards for a competent educator. Increasingly, professionals recognize that high-quality educators are more than merely expert clinicians. Although there are no specific guidelines for competency-based training of clinical educators, it is reasonable to expect that competent teachers of health professionals should be able to provide learner-centered teaching, appropriately evaluate learners, and provide effective feedback to their students (4,6).

The Importance of Evaluation

The feedback process can be divided into *formative* and *summative* information. Formative feedback consists of ongoing interventions by a teacher to assist the learner in attaining learning objectives. Summative feedback is the final overall impression of performance at the end of instruction, often referred to as evaluation. Evaluation provides tools for measuring competency and methods for determining success in helping students achieve competency. Evaluations can also help learners to understand how they are progressing and in which areas they may need additional study and practice. Assessment tools are frequently used for both formative and summative assessment in dietetic training (7).

Direct observation of students in the workplace or clinical setting is perhaps the most practical and effective method of evaluating the competency of learners in practice (3,8). However, studies have identified that the final grades students receive do not always correlate with an evaluator's judgment of a trainee's performance, thus bringing into question the reliability and validity of using direct observation in practice for evaluation (9,10). Among the faculty-identified reasons for these inconsistencies is a lack of documentation by faculty preceptors of specific deficits and uncertainty about what specifically should be documented in terms of deficits (10). The development of a structured approach that involves direct observation combined with improved tools for measuring and documenting these observations can help improve the effectiveness of clinical assessment (11).

Educators who regularly observe the performance of health professions trainees tend to have higher interrater reliability, suggesting that experience with direct observation is associated with more reliable evaluations (12). Novice dietitian preceptors report difficulty in translating required competencies into the evaluation of clinical performance, further suggesting the importance of experience (3). Additionally, formative assessment tools commonly used in dietetic training can be complex and multifaceted. These instruments, which include a tool for use within DIETetic consultations to assess COMMuncation skills called the DIET-COMMS, assume that various skills can be observed simultaneously in unpredictable clinical interactions, which can increase pressure to assess every competency, whether or not clearly observable (7). The addition of descriptors correlating with numerical scoring combined with the simplicity of a scoring system made the DIET-COMMS an easy tool to use (7). These difficulties in assessing student performance may ultimately affect an educator's ability to provide useful feedback to learners.

Understanding the Feedback Process

Nearly all learning theories stress the importance of receiving feedback in the process of learning, especially feedback on the quality of a person's performance (13). In her book, *How to Give Effective Feedback to Your Students,* Brookhart wrote that "the power of formative feedback lies in its double-barreled approach, addressing both cognitive and motivational factors at the same time" (14). Evidence demonstrates that feedback is more effective when providing information on correct rather than incorrect performance and when it is directly tied to a student's desired progression toward competency (15). Once learners understand their progress in relation to educational goals, feedback can encourage the development of self-motivated learning. Self-motivation is the key to any educational endeavor because the learner has ultimate control over precisely what content is incorporated into his or her knowledge base. Previous studies have demonstrated that external feedback and internal self-evaluation work together to assist students in deciding on their next learning goals and devising the tactics and strategies needed to reach them (14).

One meta-analysis of 131 articles identified via searches of the Social Sciences Citation Index (SSCI), PyschInfo, and the National Technical Informational Services analyzed the effects of feedback interventions (16). Included studies all were required to have a treatment group that received some type of feedback intervention and either a control or quasi-control comparison group and use performance outcome measures such as memory retention and arithmetic computations. The authors noted that although the effect of feedback on performance overall

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was positive, several studies within the analysis showed that feedback resulted in worse learner performance on the tested measures compared to the controls (16). This finding demonstrates that the feedback process is one in which information is modified by a learner's perception of the message and its intended purpose. Another investigation on the effect of feedback revealed that formative, freely written comments were associated with greater achievement of learning goals compared to receiving a letter grade or a scripted comment not related to specific performance (17). Interestingly, attempts to replicate these findings were mixed. An analysis of these studies revealed that the feedback in the replicated studies tended to be evaluative or judgmental compared with that of the original study, which specifically focused on providing encouraging comments (14). Additionally, in a study evaluating the effects of feedback on learner motivation, students receiving descriptive, task-specific feedback not only performed better, but they reported an increase in self-motivation (18).

To understand the intentions underlying the feedback process, one analysis elicited four specific types: feedback regarding the *performance* of specific tasks, feedback about the *process* of completing tasks, feedback on *self-evaluation* or *self-confidence,* and feedback about the learner *as a person* (15). Each of these models differs in effectiveness, with descriptive feedback about the task at hand producing the greatest benefit. Procedural feedback is associated with a deeper understanding of the meaning and interrelationships of a task and can shape the learner's strategy for task completion (15). More effective learners have a greater ability for self-evaluation. Feedback that encourages self-evaluation in an attempt to instill the skills of self-directed learning was shown to be beneficial only if the recipient understands the purpose and intention. Feedback about the learner as a person often is uninformative about the task at hand and rarely leads to an increased commitment to learning goals (15).

Unfortunately for students in the health professions, an emphasis on summative feedback, or evaluation, dominates within educational programs. This emphasis may result from the push for competency-based education in which the end result, a competent health professional, is paramount. Some have suggested that anxiety related to frequently recurring summative assessments coupled with high stakes, such as the need to pass academic courses, can supersed self-directed learning goals and, thus, inhibit the potential learning gains that would otherwise normally be obtained from formative assessment (19). Clinical educators should be cognizant of this dichotomy and strive to separate and distinguish these different forms of assessments to encourage student learning.

Table 1. Example Preceptor Interactions with Dietetic Interns

Scenario 1	A dietetic intern who is calculating energy requirements makes a clinically significant mistake in her calculations. Instead of multiplying the calculated basal energy expenditure by an activity factor and then multiplying again by a stress factor, she added the activity and stress factors and multiplied the calculated basal energy expenditure by that number. The preceptor points out the mistake by stating, "That's wrong. Why did you calculate the energy requirement in that manner? Don't you know the correct method?" The intern responds with a raised voice, "Well, that is how I do it!"
Scenario 2	A dietetic intern has mastered the basics of managing patients receiving enteral and parenteral nutrition. He is able to obtain daily laboratory values and collect clinical information from the flow sheet, including the amount of enteral nutrition infused, propofol calories, and intravenous fluid infusions. He is uncomfortable talking to the medical team and would prefer to send text pages with recommendations and questions instead of communicating face-to-face. He believes pager communication can relay the information as well as in-person communication.
Scenario 3	In working with a dietetic intern, who is clearly very "book smart" but having a difficult time in learning day-to-day tasks, her preceptor gives her 1 hour to complete three tasks. The tasks must occur in the following order before parenteral nutrition can be ordered for the day: 1) call the laboratory to add phosphorus and triglyceride levels to the morning report, 2) obtain the current rate of propofol received and calculate fat calories from the infusion, and 3) calculate the goal parenteral nutrition for the solution. After 1 hour, the preceptor discovers that the intern has not called the laboratory or looked at the flow sheet, but she has completed the goal parenteral nutrition calculations. When asked why she didn't complete all the tasks, the intern says, "I just started the calculations right away. I guess I got tied up in that."

The Characteristics of Effective Feedback

According to Chan and associates (20), the feedback process integrates "(a) clear learning targets, (b) evidence of student learning, and (c) student ownership." Thus, feedback is an essential component of any curriculum. Perhaps the greatest barrier to providing effective feedback is that no single method is appropriate for all students all of the time (14). Providing effective feedback requires consideration of the timing of the intervention, the amount of information given, the method of conveying the feedback, and the intended audience. Effective feedback also consists of specific comments, whether positive or negative, focused on a particular learning goal that is fully understood by the learner. The instructor must pay close attention to the tone of the feedback to enhance its effectiveness. When providing feedback to learners, several specific factors can enhance the utility and effectiveness of the process.

Create an Accepting Environment

A positive learning climate is necessary for students to receive feedback successfully. Students should not feel threatened or worried that feedback will be provided in a derogatory or insensitive manner. Students should feel that the focus of their teacher is to help them succeed and develop competency. To create such safe environments, formative feedback must occur regularly, focus on the task undertaken, avoid pronouncements of student worth, normalize error, and allow for the establishment of goals (3,20).

Students should have an anticipation and expectation of feedback. They should feel comfortable with the inevitability that they will make mistakes and their supervisor will seek to help them improve and avoid such mistakes in the future. Mistakes are learning opportunities and an important part of the educational process. Learner-centered environments allow for the development of mutual trust. Given the importance of the learner's perception of the utility of feedback, it is important to create environments in which constructive criticism is considered positive and students understand that practice is a critical component of learning (14).

The acceptance of feedback by a recipient also depends on assessor credibility. If feedback is offered by a credible, respected individual in a nonthreatening manner, learners are more likely to believe that it is an accurate portrayal of their competence (13). If teachers demonstrate their commitment to their students' learning by valuing the feedback process, students' perception of the intention of feedback can transition from punitive to educational (20). At times, it is also important to consider the physical environment in which feedback is given (21). Sensitive corrective feedback is not appropriate in a group setting, with other teachers or the learners' peers present. Discussions of serious or substantial amounts of corrective feedback should take place in a quiet location free from interruptions, and the teacher should set expectations in advance that the session will focus on feedback.

Consider how the student in Scenario 1 perceives her learning environment (Table 1). Although direct and immediate feedback is essential because the clinical error affects patient safety, the student displays a defensive attitude toward such feedback. Possibly she views her preceptor as overly judgmental or she does not trust that her preceptor understands her learning goals and needs based on the comments made by the preceptor. Clinical educators should give careful consideration to how feedback is presented to their students and ensure use of nonjudgmental tones and a focus on the performance of specific tasks. In this scenario, the preceptor should explain the specifics of the miscalculation, including the potential clinical consequence of such an error, while indicating that such errors are normal during the training process.

Focus on Behaviors, Not the Individual

When providing feedback, a teacher should employ language that describes what he or she observed the learner do (22). Direct observation of learners is essential to providing high-quality feedback. Feedback should not describe the overall quality or value of the student. By focusing on actions, feedback highlights behaviors that the student can seek to repeat or improve. The intention of the feedback is clear when focusing on task performance and avoids the risk of placing a value judgment on the learner and, thus, possibly reducing his or her receptivity.

A teacher should only focus on behaviors that are amenable to change (23). Providing feedback on a behavior or attribute that the learner has no power to change will result in no improvement and risks demoralizing the student. For example, when working with a student for whom English is not his or her first language, providing feedback about a distracting accent is counterproductive and may damage the student-teacher relationship. Teachers should stay alert for behaviors that they seek to maintain as well as behaviors that can be constructively corrected, with strategies for behavior modification that can result in future improvement.

When possible, teachers should use "I" statements in providing negative or corrective feedback, such as "I feel…" or "I noticed…" (23). Use of phrases focused on a teacher's perceptions rather than concrete statements aimed exclusively at the learner can help to avoid negative feedback from becoming statements about a learner's worth. Defensive learners may quibble with a declarative statement that they perceive to be inaccurate or a value judgment. The use of "I" statements makes it more difficult for a learner to deny that he or she performed a behavior that prompted the teacher to take note or created a particular perception in the observer. With this established, the teacher and learner can focus on the specific behaviors observed, why they may have led to a particular feeling or perception in the teacher, and how they could be modified in the future.

Be Specific

Research has documented a high prevalence of nonspecific feedback in the evaluation of medical trainees, which is ultimately of limited utility to learners. Even in an analysis of positive written feedback, a relative lack of specific praise was noted, demonstrating the breadth of the problem (19). Statements such as "Good job" or "Nice work" fail to provide students with sufficient detail to understand what they should repeat in the future. By providing both positive and negative feedback on specific behaviors, clinical educators can increase the overall effectiveness of the learning process (20). Detailed input can help students to understand what they should repeat as well as what they need to correct at the next performance opportunity.

Compare to a Standard

Specificity can be enhanced by tying behavioral feedback directly to individual competency-based learning goals and objectives. Accordingly, educators must have a clear understanding of the learning objectives for their curriculum. By providing feedback in the context of specific learning objectives, the task and the purpose of feedback become clear to both learner and teacher, thus promoting a collaborative learning effort. Health profession oversight boards, such as the Accreditation Council for Graduate Medical Education and the Commission on Dietetic Registration, have created standardized competency requirements for the successful completion of professional training. These competencies provide a framework for the assessment and evaluation of individual students with a clearly delineated expected trajectory of development. Training programs can inform students of these expectations, leading to a shared understanding of entry-level competency from which individual learning goals may be set and monitored (3). Having competency-based goals and objectives that are clear to both students and teachers allows for comparison of performance to a known standard, which may also be of use in promoting self-directed learning.

In the preceptor-student interaction described in Scenario 2 of Table 1, the student performs his tasks without difficulty but does not appear to demonstrate competency in his communication skills. Communication is one of the 14 required competencies in the *Essential Practice Competencies for the Commission on Dietetic Registration's Credentialed Nutrition and Dietetics Practitioners,* with emphasis on appropriate communication, collaboration with various team members in the provision of care, and the facilitation of teamwork within the medical setting (24). The student in the scenario incorrectly believes that communication by pager is sufficient to demonstrate competency. During the feedback session, in addition to acknowledging this intern's mastery of the necessary steps involved in providing enteral and parenteral nutrition, his preceptor could review the expectations of communication required of all registered dietitian nutritionists, which include the ability to communicate with other clinical providers to facilitate appropriate care. For this student, who may be prone to defensiveness because of his apparent discomfort with interpersonal communication, starting a session by focusing on the specific competencies can reduce his anxiety, reinforce the reason for learning and practicing this skill, and avoid the risk that he perceives feedback in this area as an assessment of his personal worth.

Be Timely

The timing of feedback is critical (25). Ideally, feedback is provided close in time to the period in which the learner's behavior and teacher's observation occurred. This is the period when recollection of the behavior is freshest in the learner's mind and he or she is often most receptive to recommendations for modification (20). Timely feedback also provides the opportunity for further reflection before performing the behavior again. Of note, providing immediate sensitive corrective feedback may not be appropriate or wise. The learner might still be upset if it was a troubling interaction and may not be prepared to accept feedback surrounded by colleagues or peers. In these circumstances, feedback may need to wait until the teacher can arrange for a more suitable environment, although the instructor still should not to let too much time pass before addressing behaviors that need correction.

Provide the Appropriate Amount of Feedback

Although formative feedback may improve performance, too much information can overwhelm or discourage students. Cognitive load theory suggests that the amount of new information that can be processed is directly related to the effort required for processing. The intrinsic load relates to the inherent difficulty or complexity of a task, and the extraneous load refers to the manner in which information is presented (26,27). Increasing either the intrinsic or extraneous load decreases a learner's ability to process information effectively and, in the case of feedback, can diminish its educational value.

Feedback effectiveness can be improved if clinical educators limit their comments and focus on a few clear learning targets, thus reducing the amount of relevant information the student

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needs to process (20,28). Teachers should try to focus exclusively on essential observed behaviors they seek to maintain or modify that are relevant to the specific learning objectives for the student. Providing small amounts of feedback with increased frequency can reduce the chance of overwhelming the learner with too much information while also offering more opportunities for practice and application of the lessons learned from the feedback.

Encourage Self-directed Learning

Inviting students to share their self-assessment before providing feedback can effectively promote both self-directed learning and an accepting environment (21). Student ownership of learning is an essential part of the educational process because students control which learning opportunities merit their attention. Involving learners in the assessment process promotes success because the teacher can attempt to align student goals with learning objectives and help direct their clinical experiences (3,20). Through this process, educators can ensure that student goals are measurable, challenging, and achievable (20). Self-reflection and the ability to appropriately assess one's own skills is a critical component of lifelong learning, and dietetic resources emphasize the importance of conducting regular self-assessment to identify areas of weakness (29). Furthermore, preceptors overwhelmingly believe that part of their role is to empower learners to take control of their own learning rather than having the preceptor direct learning goals (2).

The dietetic intern in Scenario 3 (Table 1) initially may appear inefficient or lazy, but before arriving at this conclusion, the preceptor should consider why the intern was unable to complete her tasks. Her personal interests and learning goals may be related to the calculations required for parental nutrition. Instead of focusing on tasks that the intern failed to complete in a timely manner, the preceptor should inquire about the student's interest in the calculations to align the intern's potential learning goals with the learning objectives for the rotation. Armed with this information, the preceptor can then relate the other tasks to the successful attainment of her learning goals, such as the need to assess electrolytes in the adjustment of parental nutrition, and encourage her self-motivation for learning in addition to creating a safe educational environment. However, the preceptor also must emphasize the essential need to perform critical clinical tasks reliably, regardless of a student's personal learning goals and desires.

Solicit Feedback from the Student

In a truly accepting environment, instructors solicit feedback on their own performance from their learners (30). This practice not only encourages an open and honest environment for feedback, but it provides opportunities for teachers to improve their teaching skills. An especially helpful approach after providing corrective feedback is to ask learners about how they felt when provided with the feedback and if they might have suggestions for improving feedback delivery in the future. Even small improvements in a preceptor's skill or comfort with giving feedback could have substantial effects on student learning outcomes.

The Use of Feedback in Health Professions Education

Understanding the importance of formative feedback in the educational process and applying the characteristics of effective feedback in teaching (Table 2) represent only the initial step in the overall improvement of the feedback process in health professions education. The next step is to determine the manner in which clinical teachers should incorporate feedback into the educational landscape. Effective mentoring in the field of nutrition and dietetics involves providing useful feedback and creating an environment of mutual trust and respect, which has been found to correlate with an improved sense of self-efficacy (2,31).

Similar to mentoring, research on tutoring has demonstrated greater promotion of both student learning and motivation to learn when compared with traditional, formal classroom teaching (32). The behaviors of expert tutors reveal similarities between the characteristics associated with good tutoring and those of effective feedback. These include establishing and maintaining good rapport and empathy, allowing for student self-reflection, and being encouraging to bolster confidence (32). One of the most helpful remediation interventions when dealing with struggling learners within the medical field is the use of frequent feedback sessions, which demonstrates the versatility of this skill (8).

Although research into the benefits of feedback has documented improvements in physician performance, those who lack insight into their own strengths and weaknesses are more likely to have poor clinical performance and less likely to improve their skills (15,33). Trainees often have difficulty in assessing their own performance and level of competency. Dietetic educators report more challenges in the evaluation of students who perform poorly, lack insight into their abilities, or are not receptive to feedback (3). Feedback tends to be welcomed by students in the health professions to assist in their professional development, but there is also a perception that the evaluation process is undervalued by clinical educators due to a lack of interest, time, or appropriate amount of interaction with the learners (33). In addition to time constraints, dietetic educators felt that their preceptor activities were not recognized or valued in the work environment, which can lead to feelings of being overburdened by the need to balance multiple work priorities with teaching (2).

The literature on feedback rarely focuses on methods to overcome these barriers, although methods in medicine such as the clinical microskills or the six-step learner-centered SNAPPS model (Summarize the case, Narrow the differential, Analyze the differential, Probe the preceptor about areas of uncertainty, patient Plan creation, and select a Self-directed learning topic) were developed to address precisely such concerns (34,35). These models include applying techniques to make explicit the learner's understanding and reasoning process related to a task, limiting feedback to one or two comments relevant to key deficits identified in this process, and making this process a routine part of the

Table 2. Suggestions for Applying the Characteristics of Effective Feedback

Characteristics of Effective Feedback	Suggested Applications
Create an Accepting Environment	Use a nonjudgmental tone Normalize mistakes (as a normal part of learning) Make feedback an expected part of teaching
Focus on Behaviors	Emphasize personal direct observations Limit to behaviors amenable to change
Be Specific	Relate to learning goals (goal-oriented) Focus on performance of tasks (task-specific)
Compare to a Standard	Inform the learner of basic competency requirements Provide the anticipated trajectory toward competency
Be Timely	Give feedback immediately after clinical interactions
Give the Appropriate Amount	Limit to clearly defined learning targets
Encourage Self-directed Learning	Involve the learner in setting goals Provide time for learner self-reflection Encourage interests and motivate learner
Solicit Feedback from the Learner	Attempt to improve one's skill in providing feedback

clinical encounter. Taking notes on observed behaviors can also provide a structure for providing specific, credible feedback and addresses time constraints by allowing the preceptor to prepare for the feedback session while providing patient care (28). A variety of tools such as the mini-clinical experience exercise (mini-CEX) have been developed in medicine as part of early efforts to structure and assist clinical preceptors with performing direct observations and providing feedback (36,37).

Unfortunately, many learners report frustration at the lack of feedback received during medical training (19). Although this frustration may, in part, be due to learners not recognizing the feedback they receive as feedback, suggesting a need for preceptors to label the process, research has suggested the feedback received often is of poor quality. For example, the assessment forms used to date in dietetic education are often not particularly helpful in assessing attributes and behaviors, and clinical preceptors suggest a need for additional opportunities to record qualitative comments about performance to improve student competency (3). Additionally, qualitative studies of free-text comments on evaluation forms noted that only a small minority of feedback was supported by specific behavioral examples, and these were often not accompanied by constructive suggestions or recommendations for improvement (38,39). Furthermore, these comments were commonly vague or irrelevant to the learner's progression toward competency and frequently focused on the impact the learner had on the evaluator's workload (39). More formalized, structured approaches may yield more detailed feedback both in person and on student evaluations.

One residency program attempted an intervention involving regular feedback, guided self-assessment, and in-person meetings with faculty advisors to improve resident attainment of clinical competency (11). Although this intervention provided a more thorough assessment of learner performance, faculty members overall were ill-prepared to provide good formative feedback or assist trainees in the effective utilization of feedback (11). Because inappropriate or poorly constructed formative feedback can affect trainees negatively by reducing the intrinsic motivation to learn and several studies have documented a lack of specific, behaviorally based feedback, training programs must address faculty deficits in these areas (33). Fortunately, even brief faculty development interventions have been shown to improve the quality of feedback, suggesting that it is a learnable skill (28). Underlying the culture of biomedicine are negative messages emphasizing the need for perfection, the avoidance of uncertainty and complexity, and the focus on outcomes instead of processes that undermine the natural error inherent in the learning process (40). Attempts to change this environment, along with the integration of characteristics for effective feedback, could perhaps create non-shaming environments open to formative feedback as a mechanism for the further promotion of learning within the health professions.

Conclusion

Although clinical preceptors within health professions often lack formal training in teaching skills, research on the benefits of formative feedback has identified several key characteristics associated with effective feedback that can be incorporated into clinical teaching with ease. These characteristics include the creation of an environment receptive to feedback, focusing on observed learner behaviors, specificity of feedback, comparison to a standard of competency, timeliness of comments, ensuring an appropriate amount of feedback so as not to overwhelm the learner, and encouragement of self-directed learning and self-assessment. Dietetic preceptors can and should be able to apply these elements to teaching encounters to assist in the evaluation and assessment of dietetic trainees. Furthermore, expert educators solicit feedback from their learners to create positive learning environments, improve their own competency as teachers, and demonstrate the appropriate response to constructive feedback. Interventions targeted toward the improvement of faculty competence in providing appropriate feedback are crucial for learning. The creation of environments receptive to constructive, formative assessment may play a major role in changing the focus of biomedical training from outcomes to the educational process and progression of the learner.

CPEU questions for this article can be accessed at dnsdpg.org.

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References

1. Roberts NJ, Brockington S, Doyle E, et al. Innovative model for clinical education in dietetics. *Nutr Diet.* 2009;66(1):33–38.
2. Nasser R, Morley C, Cook S, Coleman J, Berenbaum S. Dietitians' perceptions of precepting: knowledge, skills, attitudes, barriers, and training. *Can J Diet Pract Res.* 2014;75(1):7–14.
3. Palermo C, Beck EJ, Chung A, et al. Work-based assessment: qualitative perspectives of novice nutrition and dietetics educators. *J Hum Nutr Diet.* 2014;27(5):513–521.
4. Srinivasan M, Li S-TT, Meyers FJ, et al. "Teaching as a Competency": competencies for medical educators. *Acad Med.* 2011;86(10):1211–1220.
5. Fitzgerald JT, Burkhardt JC, Kasten SJ, et al. Assessment challenges in competency-based education: A case study in health professions education. *Med Teach.* 2015 June 8:1–9.
6. Boerboom TBB, Dolmans DHJM, Muijtjens AMM, Jaarsma ADC, Van Beukelen P, Scherpbier AJJA. Does a faculty development programme improve teachers' perceived competence in different teacher roles? *Med Teach.* 2009;31(11):1030–1031.
7. Whitehead KA, Langley-Evans SC, Tischler VA, Swift JA. Assessing communication skills in dietetic consultations: the development of the reliable and valid DIET-COMMS tool. *J Hum Nutr.* 2014;27(suppl 2):321–332.
8. Yao DC, Wright SM. National survey of internal medicine residency program directors regarding problem residents. *JAMA.* 2000;284(9):1099–1104.
9. Cohen GS, Blumberg P, Ryan NC, Sullivan PL. Do final grades reflect written qualitative evaluations of student performance? *Teach Learn Med Int J.* 1993;5(1):10–15.
10. Dudek NL, Marks MB, Regehr G. Failure to fail: the perspectives of clinical supervisors. *Acad Med.* 2005;80(10 suppl):S84–S87.
11. Ross S, Poth CN, Donoff M, et al. Competency-based achievement system: using formative feedback to teach and assess family medicine residents' skills. *Can Fam Physician.* 2011; 57(9):e323–e330.
12. Crossley J, Jolly B. Making sense of work-based assessment: ask the right questions, in the right way, about the right things, of the right people. *Med Educ.* 2012;46(1):28–37.
13. Dudek NL, Marks MB, Bandiera G, White J, Wood TJ. Quality in-training evaluation reports—does feedback drive faculty performance? *Acad Med.* 2013;88(8):1129–1134.
14. Brookhart SM. *How to Give Effective Feedback to Your Students.* Alexandria, VA: Association for Supervision and Curriculum Development; 2008.
15. Hattie J, Timperley H. The power of feedback. *Rev Educ Res.* 2007;77(1):81–112.
16. Kluger AN, DeNisi A. The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychol Bull.* 1996;119(2):254–284.
17. Page EB. Teacher comments and student performance: A seventy-four classroom experiment in school motivation. *J Educ Psychol.* 1958;49(4):173–181.
18. Butler R, Nisan M. Effects of no feedback, task-related comments, and grades on intrinsic motivation and performance. *J Educ Psychol.* 1986;78(3):210–216.
19. Ingram JR, Anderson EJ, Pugsley L. Difficulty giving feedback on underperformance undermines the educational value of multi-source feedback. *Med Teach.* 2013;35(10): 838–846.
20. Chan PE, Konrad M, Gonzalez V, Peters MT, Ressa VA. The critical role of feedback in formative instructional practices. *Interv Sch Clin.* 2014;50(2):96–104.

(Continued on next page)

21. Hewson MG, Little ML. Giving feedback in medical education: verification of recommended techniques. *J Gen Intern Med.* 1998;13(2):111–116.
22. Branch WT Jr, Paranjape A. Feedback and reflection: teaching methods for clinical settings. *Acad Med.* 2002;77(12 Pt 1):1185–1188.
23. Ende J. Feedback in clinical medical education. *JAMA.* 1983;250(6):777–781.
24. Commission on Dietetic Registration. *Essential Practice Competencies.* https://admin.cdrnet.org/vault/2459/web/files/FINAL-CDR_Competency.pdf. Accessed October 30, 2015.
25. Gonzalo JD, Heist BS, Duffy BL, et al. Content and timing of feedback and reflection: a multi-center qualitative study of experienced bedside teachers. *BMC Med Educ.* 2014;14:212.
26. Qiao YQ, Shen J, Liang X, et al. Using cognitive theory to facilitate medical education. *BMC Med Educ.* 2014;14:79.
27. Van Merriënboer JJG, Sweller J. Cognitive load theory in health professional education: design principles and strategies. *Med Educ.* 2010;44(1):85–93.
28. Thomas JD, Arnold RM. Giving feedback. *J Palliat Med.* 2011;14(2):233–239.
29. Gates GE, Amaya L. Registered dietitian nutritionists and nutrition and dietetics technicians, registered, are ethically obligated to maintain personal competence in practice. *J Acad Nutr Diet.* 2015;115(5):811–815.
30. Kaprielian VS, Gradison M. Effective use of feedback. *Fam Med.* 1998;30(6):406–407.
31. Palermo C, Hughes R, McCall L. An evaluation of a public health nutrition workforce development intervention for the nutrition and dietetics workforce. *J Hum Nutr Diet.* 2010;23(3):244–253.
32. Wood WB, Tanner KD. The role of the lecturer as tutor: doing what effective tutors do in a large lecture class. *CBE Life Sci Educ.* 2012;11(1):3–9.
33. Ibrahim J, MacPhail A, Chadwick L, Jeffcott S. Interns' perceptions of performance feedback. *Med Educ.* 2014;48(4):417–429.
34. Neher JO, Gordon KC, Meyer B, Stevens N. A five-step "microskills" model of clinical teaching. *J Am Board Fam Pract.* 1992;5(4):419–424.
35. Wolpaw TM, Wolpaw DR, Papp KK. SNAPPS: a learner-centered model for outpatient education. *Acad Med.* 2003;78(9):893–898.
36. Norcini JJ, Blank LL, Duffy FD, Fortna GS. The mini-CEX: a method for assessing clinical skills. *Ann Intern Med.* 2003;138(6):476–481.
37. Sidhu RS, Hatala R, Barron S, Broudo M, Pachev G, Page G. Reliability and acceptance of the mini-clinical evaluation exercise as a performance assessment of practicing physicians. *Acad Med.* 2009;84(10 suppl):S113–S115.
38. Speer AJ, Solomon DJ, Ainsworth MA. An innovative evaluation method in an internal medicine clerkship. *Acad Med.* 1996;71(1 suppl):S76–S78.
39. Vivekananda-Schmidt P, MacKillop L, Crossley J, Wade W. Do assessor comments on a multi-source feedback instrument provide learner-centred feedback? *Med Educ.* 2013;47(11):1080–1088.
40. Haidet P, Stein HF. The role of the student-teacher relationship in the formation of physicians. The hidden curriculum as process. *J Gen Intern Med.* 2006;21(suppl 1):S16–S20.

Probiotics in the Neonatal Intensive Care Unit

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Abstract

The use of probiotics in the neonatal intensive care unit (NICU) appears to be gaining support throughout the world, but such use is not yet routine in the United States. Understanding the various types of products that are used, how they affect microorganisms in the neonate, and their potential role in addressing gastrointestinal issues in these infants can aid registered dietitian nutritionists (RDNs) in addressing this controversial topic.

Introduction

RDNs have been discussing the use of probiotics in the NICU for the past several years. One aspect of this controversial topic that has received substantial attention is routine probiotic use specifically for preterm infants. There is evidence to support use but the actual implementation raises some concern.

To engage in this discussion, RDNs need to understand the commonly used terms (1):

- A **probiotic** is an oral supplement or a food product that contains a sufficient number of viable microorganisms to alter the microflora of the host and has the potential for beneficial health effects.
- A **prebiotic** is a nondigestible food ingredient that benefits the host by selectively stimulating the favorable growth and/or activity of one or more indigenous probiotic bacteria. Human milk is a natural prebiotic. The oligosaccharide content of human milk is high and is part of its prebiotic components.
- A **synbiotic** is a product that contains both probiotics and prebiotics. Synbiotics may be separate supplements or may exist in functional foods as food additives.
- **Microbiota** refers to a population of microscopic organisms that inhabit an organ or portion of a person's body.
- **Microbiome** refers to the unique population of microorganisms and their complete genetic elements that inhabit a person's body.

Probiotics

Probiotics are live microorganisms that, when administered in adequate amounts, can confer a health benefit on the host (2). Probiotics are typically bacteria or yeasts that colonize the gastrointestinal (GI) tract. The most frequently used probiotics are *Lactobacillus* and bifidobacteria (3). These are of specific interest in the neonatal field. Both are present in breast milk and belong to a group of bacteria called lactic acid bacteria (4).

Neonatal Microbiome

The GI tract of a healthy fetus is relatively sterile at birth (5). However, several factors can influence gut flora in the neonate:

1. *Mode of delivery (vaginal versus cesarean).* A vaginally delivered infant acquires bacterial communities resembling his or her mother's vaginal microbiota. Infants delivered via cesarean section harbor bacterial communities similar to those found on the skin surfaces of their mothers and other individuals in the delivery room (6).
2. *The environment.* Initial colonization of the newborn's GI tract is highly dependent on the environment. Preterm infants have been found to have similar bacterial strains as are present in the NICU (7).
3. *Initial feedings or lack of feedings/parenteral nutrition.* An obvious difference between breastfed and formula-fed newborns is the development of the intestinal flora, which is important for protection against harmful microorganisms and for maturation of the intestinal immune system (8). In healthy breastfed infants, bifidobacteria predominate in the digestive tract, with some lactobacilli. Thus, breastfeeding might contribute to the initial establishment of the microbiota in the newborn (9). Fewer bifidobacteria are present in the digestive tracts of formula-fed infants (10). Researchers examining the association of cesarean delivery and formula supplementation with the intestinal microbiome of 6-week-old infants concluded that the infant intestinal microbiome at approximately 6 weeks of age is significantly associated with both delivery mode and feeding method (11). In this study, supplementation of breast milk feeding with formula was associated with a microbiome composition that resembled that of infants who are exclusively formula fed. (11).

Some of the functions of the microbiome include nutrient acquisition, immune programming, and protection against pathogen invasion (12).

Antibiotics

Preterm infants have immature immune systems and compromised gut mucosa. The use of antibiotics may disrupt the neonatal gut microbiota (13). Antibiotics not only attack the disease-causing bacteria, but they affect other bacteria as well. Infants admitted to the NICU are also frequently exposed to broad-spectrum antibiotics, which can