DEVELOPING SIMULATION TO MEET PRACTICE COMPETENCIES AT A COORDINATED PROGRAM IN DIETETICS

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By

JENNIFER ANDERSON

Dr. David Bergin, Thesis Supervisor

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

DEVELOPING SIMULATION TO MEET PRACTICE COMPETENCIES AT A COORDINATED PROGRAM IN DIETETICS

presented by Jennifer Anderson,

a candidate for the degree of master of arts,

and hereby certify that, in their opinion, it is worthy of acceptance.

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Professor David Bergin

_____

Professor Matthew Easter

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Professor Le Greta Hudson

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DEVELOPING SIMULATION TO MEET PRACTICE COMPETENCIES AT A COORDINATED PROGRAM IN DIETETICS

Jennifer Anderson

Dr. David Bergin, Thesis Supervisor

ABSTRACT

Dietetics programs have begun to incorporate simulations into curriculum in the last few decades. Simulations are replicated patient interactions that can use Standard Patients, which are trained human actors who role-play a patient. Standard Patients provide real-life clinical scenarios for students to practice skills learned in the classroom. Previous research has shown that implementing simulation into dietetics training can provide benefits to dietetic students such as practicing skills in a low-risk environment, experiencing exposure to complex clinical cases, and receiving high quality feedback from evaluators. This observational study investigated the effect of using Standard Patient simulations to measure nutrition care and communication ACEND® competencies across three simulation events and two evaluator methods.

Forty Master's dietetic students at the University of Missouri participated in three consecutive simulation events across two years of instruction. Simulation events were observed and evaluated by the Standard Patients and faculty of the program.

A repeated-measures *ANOVA* technique was used to test for change in Standard Patient and faculty evaluations of nutrition care and communication competencies across the three events. The Standard Patient and faculty ratings of nutrition care improved across time but not significantly, though nearly significantly ($p = 0.054$, and $p = 0.067$, respectively). No significant differences were observed across communication scores.

Simulation is an innovative and useful educational tool to use in dietetics training. Future research can help further establish how to use simulation most strategically with consideration of available resources.

Introduction

Maintaining optimal health is an elevated concern for Americans. Medical advancements make it possible for people to have longer life-expectancies, and more medical treatments are available than ever before. Registered dietitians – credentialed nutrition experts in the US – have a major role in this longevity of Americans. They are uniquely trained to provide evidence-based nutrition interventions in a variety of settings, including hospitals, outpatient clinics, community education, and public policy. Examples of nutrition interventions include but are not limited to the following: educating individuals to improve diet quality, providing high-energy supplements for hospitalized patients who are losing weight due to illness, and calculating tube feeding needs for patients who are unable to eat by mouth. To become a registered dietitian in the US, one must complete a professional program through an accredited university (*ACEND*®, 2021). In these professional programs, it is necessary to measure competence of the nutrition interventions for the variety of professional settings in which registered dietitians practice. Dietetics programs are faced with using paper-based case studies that do not measure actual nutrition care competence or demonstrate real-world ability with actual patient interactions. Because dietetics is a profession that involves integration of evidence-based nutrition care with effective communication skills, more adequate methods are needed to train dietetic students for the real world and measure competence as they demonstrate these skills.

To achieve this goal of effective training and measurement of competence, dietetics programs have begun to incorporate simulations into curriculum. Simulations are replicated patient interactions for which program hires people to pose as patients with specific nutrition problems. Allowing dietetics students to practice their skills in a realistic clinical scenario with a

seemingly real patient provides an authentic interaction that prepares students for the clinical setting.

While much of the current simulation research has focused on the benefits in healthcare professions such as medical and nursing students, less is known about including simulation in dietetics training. Based on the literature that is available, simulation has the possibility to provide advantages in dietetics programming by allowing dietetic students to practice their skills in a low-risk environment, execute nutrition interventions for complex clinical scenarios, and receive feedback on their performance from faculty and peer evaluators (Safaii-Waite, 2019).

While several dietetics programs across the nation are using simulations for their curriculum, there is still little published on this topic. Many previous studies in dietetics simulation investigate learning outcomes that are perception based – those studies indicate that simulation is a well-accepted learning method among dietetic students, and that students generally perceive that they learn from simulation. Few studies show direct measurement of learning outcomes, which is the next step for expansion in dietetics simulation research. The current study directly measured learning outcomes in 40 students using US competencies established by the dietetics profession.

Literature Review

This literature review describes simulation use in healthcare education. It begins by outlining established program components in medical and nursing education. Following this, the focus turns to dietetics training by highlighting these areas: 1) components of simulation education programs, 2) past metrics for simulation efficacy in dietetics education, and 3) aspects of simulation that are particularly effective in preparing students for the clinical environment.

A History of Use of Simulation in Clinician Training

Learning through simulation is a common educational tool for healthcare professionals (Reising et al., 2011). According to the *Healthcare Simulation Dictionary*, simulation-based learning experiences are "an array of structured activities that represent actual or potential situations in education and practice. Simulation activities allow participants to develop or enhance their knowledge, skills, and attitudes, or to analyze and respond to realistic situations in a simulated environment" (Lopreiato, 2016). Simulations are useful because they allow educators to present students with situations that would be difficult, expensive, or dangerous to create in real life. It could be very difficult and impractical to find people with muscle wasting to present to students for them to practice diagnosing malnutrition. It would be dangerous for students to provide medical nutrition therapy without practice and preceptor feedback due to the potential for unhealthy advice. Due to these factors, as well as the limited availability of dietetics preceptors in the field, simulation can provide effective practice opportunities for dietetic students.

Simulation has been shown to increase student confidence in their skills (Henry et al., 2009) in a safe environment, promote better outcomes for the clinician in training, and increase the quality of care and safety of patients (Gaba, 2004).

Types of Simulation

Many kinds of simulation are found in the literature; they include standard patients (SPs) and computerized patient simulators. Both will be discussed in this document.

SPs are trained human actors who role-play a patient. In MU's Coordinated Program, the simulations with SPs occur in the Sheldon Clinical Research Center. Cameras and speakers are installed in a room that is set up to look like an inpatient or outpatient clinical room. The SP is

waiting in the room for the student to enter and is prepared to present a particular patient profile. Students are encouraged to follow typical protocol for clinical settings, such as handwashing before and after the visit, to make the experience identical to how the student would perform in a real-world setting. One benefit of using SPs is the realistic feature of utilizing "soft skills." For example, students are required to think on their feet to exhibit interpersonal skills. One study demonstrated that interactions with SPs are very similar to an authentic clinical interaction with real patients (Schwartz et al., 2015). The SP, in combination with the realistic clinical environment, can assist preparing students for the real-life communication that happens in the clinical setting.

Low-, medium-, and high-fidelity simulators are also discussed and utilized in the present study. High-fidelity simulators refer to a computer-programmed, full-bodied mannequin as the patient that provides real-time feedback (McCoy et al., 2019). The other levels (low- and medium-fidelity), refer to variations in technology resulting in how realistic the simulator is. Low-fidelity could still be a mannequin, but that has limited communication abilities. In one study (Brydges et al., 2010), the low-fidelity simulator was a computer-system that looked like a patient but did not have capability for students to draw blood and had limited ability to respond to the student. In the same study, the high-fidelity simulator had blood in its veins and responded to the student using a loudspeaker from which a staff member behind the scenes was responding with a script. High-fidelity simulations are used often in healthcare training, specifically in emergency and anesthetic medicine because of the ability to assess high-risk skills that are necessary in these areas (Ryall et al., 2016).

Simulation in Medical Schools

Simulation in medical schools have been well-documented in the literature in a variety of clinical scenarios (Ryall et al., 2016). High-fidelity simulation improved performance outcomes in CPR training for medical students when compared to traditional training (McCoy et al., 2019). In the context of coronary angiography training, high-fidelity simulation improved medical students' knowledge and skills, as well as provided a satisfying learning experience (Fischer et al., 2018). Takayesu et al. (2006) found that among 95 clinical students in various medical settings, students valued the high-fidelity simulation experience, and 91% of the students suggested the simulation should be mandatory in medical education. Including simulation in medical school curriculum provides a well-perceived, hands-on approach to clinical scenarios in a safe environment before students provide higher-risk patient care.

Simulation in Nursing Schools

Simulation in nursing education is so extensive that Cant et al. (2017) published an umbrella systematic review of simulation-based education in undergraduate nursing education, which included both high-fidelity simulation and SPs. This review found that simulation improves self-efficacy compared to control groups in experimental designs. Other studies in the review reported simulation improved clinical judgment and critical thinking, but results for improvements in confidence and competence were mixed. Overall, the review found that simulation is a satisfying learning experience for nursing students.

Wilson and Klein (2012) evaluated high-fidelity simulations in the context of graduate nurses. Students reported the experience was helpful to expand and build upon current knowledge. Tamaki et al. (2019) investigated the use of SPs in end-of-life care for nursing students in a randomized, controlled trial. The study showed a significant improvement in

knowledge, skill, and reported self-confidence when compared to a control group. In a study focusing on palliative care, Kirkpatrick et al. (2019) showed that SPs resulted in improvements in students' knowledge and performance. In summary, these studies exhibit the use of simulations to improve clinical skills in nursing students.

Simulation in Other Healthcare Fields

While simulation is common in nursing and medical school curriculum, the technique applies to other clinical disciplines as well. Ward et al. (2015) investigated the use of high-fidelity simulation in speech-language pathology training programs and found that simulation improved self-reported confidence and skills of students (Ward et al., 2015). In a 2015 systematic review of simulation in auditory education, simulation groups had higher overall training scores post-simulation than pre-simulation (Dzulkarnain et al., 2015).

Williams et al. (2016) conducted a review exploring research on effectiveness of SPs on clinical competence in a variety of healthcare students, including medical, nursing, dentistry, occupational therapy and physiotherapy students. Out of these studies, technical skills (i.e. physical exams), non-technical skills (i.e. communication skills with patients), and cognitive skills (i.e. clinical judgment) were included as clinical competence domains. Results indicated simulation with SPs provided the following: reliable practice opportunities for technical skills, improvements in interpersonal skills, and development of clinical judgment. These studies indicate the benefit of simulations on clinical learning outcomes across many healthcare professions.

Expansion of Research on Simulation in the Dietetics Field

Simulation can offer the same benefits to dietetics students as other healthcare professionals, including developing practice skills in a lower-risk environment, recording

sessions to improve quality of feedback, and increasing overall confidence in the clinical setting (Safaii-Waite, 2019). While benefits of simulations have been investigated in other healthcare professions for the last few decades (Gaba, 2004), simulation in dietetics education is not as well-documented in the literature. In 2015, the Academy of Nutrition and Dietetics called for an expansion of research on simulation in the field of dietetics (Thompson & Gutschall, 2015). Since then, more simulation in dietetics training has been investigated.

Published Research on Simulation in Dietetics

The next section reviews published papers on simulation in dietetics describing current outcomes and measurement tools. Table 1 describes studies demonstrating use of simulation in dietetics training, organized by what was measured.

Table 1

Studies demonstrating use of simulation in dietetics training.

Author (year)	Type of simulation	# of events	Measurement	Findings	Evaluation method
Todd et al. (2016)	High-fidelity	1	Perceived confidence	Improved	Pre- & post-event student surveys
O'Shea et al. (2019)	SP[2]	1	Perceived confidence	Improved	Pre- & post-event student surveys, and 2 weeks after starting clinical rotation
Wright et al. (2019)	SP	1	Perceived confidence	Improved	Pre- & post-event student surveys
Farahat et al. (2015)	SP	1	Perceived confidence & readiness for clinical setting	Improved	Pre- & post-event student surveys, focus group discussion
Schumacher et al. (2020)	High-fidelity	1	Perceived confidence & knowledge	Improved	Pre- & post-event student surveys, during event by trained assessors and SPs
Hawker et al. (2010)	SP	1	Nutrition care	Improved	During event and after clinical rotations by dietetics preceptors
Tada et al. (2018)	SP	1	Self-efficacy	Improved	Pre- & post-event student surveys
Gibson et al. (2016)	SP	2, two weeks apart	Communication	Improved	Pre- & post-event student surveys, during event by trained assessors
Tyler et al. (2020)	Role play[3], SP	2, time varied	NFPE[1]	Improved	During event by trained assessors
Buchholz et al. (2019)	SP	2	Communication & nutrition care	Improved	During event by trained assessors & SPs

Note. [1]NFPE – Nutrition focused physical exam, [2]SP – Standard Patient, [3]Role play – where a classmate acts as the patient

The studies in Table 1 focus on simulation in the dietetics field that involved either high-fidelity simulators or SPs. One study also included a role-play scenario, which was described as a classmate acting as the patient for practice before the simulation with the SP (Tyler et al.,

2020). Studies that are discussed have measured impact of simulation on the following: perception of confidence, knowledge, readiness for clinical setting; communication; and nutrition care.

Perception of Confidence, Knowledge, and Readiness for Clinical Setting

Schumacher et al. (2020) tested perceived knowledge and perceived confidence via student surveys before and after a tube feeding insertion on a high-fidelity patient and found perceived confidence and knowledge improved. While the study tested a specific nutrition care skill, it did not directly measure actual skill improvements; rather, it measured the students' *perception* of their improvements. Todd et al. (2016) measured perceived confidence before and after a high-fidelity simulation, as well as after their clinical rotations started. They found that the high-fidelity simulation improved the students' self-efficacy before starting their clinical rotations. They did not measure any specific skill or performance. Wright et al. (2020) included evaluation of perceived confidence in nutrition care performance before and after a SP simulation in the inpatient setting and found perceived confidence improved post-simulation. They also reported the simulation was perceived as valuable by the students, but did not include an objective measurement of nutrition care skills and performance. Their results were consistent with a study showing use of SPs in nutrition counseling improved perceived confidence and readiness for the clinical setting (Farahat et al., 2015). Similarly, a study on SPs in dietetic students showed an improvement of self-efficacy on nutrition care skills (Tada et al., 2018).

While self-efficacy can predict skills and performance, it is not the same thing. Research shows that measures of perceptions of learning are a weak substitute for measures of actual learning and may be misleading (Carpenter et al., 2013). A study of nursing students in a

simulation program found no correlation between self-reported confidence and observed clinical performance (Liaw et al., 2012).

Nutrition Care Skills

A few studies have shown direct measurements of skill in nutrition care. The Nutrition Care Process, established by the Academy of Nutrition and Dietetics, is a "systematic method to providing high-quality nutrition care (*Nutrition Care Process*, 2021)." This includes the following parts: Assessment, Diagnosis, Intervention, and Monitoring/Evaluation (*Nutrition Terminology Reference Manual (eNCPT): Dietetics language for nutrition care*, 2021). This is described further in Table 2.

Table 2

Nutrition Care Process

Steps	Description	Examples
Assessment	Collection of nutrition-related data	Body weight history, daily food intake, food allergies
Diagnosis	Establishing a specific nutrition problem, the reason for the problem, and the evidence of the problem	Inadequate oral intake related to poor appetite as evidenced by patient report and weight loss of 15% in 3 months.
Intervention	Plan for addressing the nutrition problem	Meals and Snacks: Providing a high-energy nutrition shake 1 time per day in the afternoon.
Monitoring/Evaluation	Data that will continue to be collected	Body weight, tolerance to shake

Nutrition care skills have been measured using SPs in a few studies. Hawker et al. (2010) studied the use of SP on nutrition care skills, specifically performance in nutrition assessment, and found that simulation was useful to predict performance in the clinical setting. This study was unusual because it measured actual performance; performance of skills was measured by

trained assessors and senior dietetics preceptors. Another study that measured performance used SPs and nutrition-focused physical exam skills (Tyler et al., 2020). A nutrition-focused physical exam is a method of measuring the physical nutritional status of a patient. If a patient has had a poor appetite resulting in recent weight loss and decline in physical functioning, this can be assessed by the nutrition-focused physical exam. This includes observation and evaluation of fat loss, muscle loss, and evidence of other malnutrition-related symptoms. The clinician physically feels presence of fat loss and muscle loss on specific places on the patient's body, such as the face, shoulders, and arms. Tyler et al. found it was impractical to find healthy human actors for the SP role with all symptoms of malnutrition, so the SPs chosen for the study were thin actors who verbally reported symptoms if they did not physically have them. While it is a limitation that SPs might not have true physical symptoms of malnutrition, the major advantage of simulation for conducting nutrition-focused physical exams is helping students feel more comfortable touching patients (Tyler et al., 2020).

The nutrition-focused physical exam is typically done in the hospital setting to identify malnutrition, which can then be treated by the registered dietitian and in turn, improves patient outcomes (White et al., 2012). Diagnosing malnutrition correctly and efficiently is essential in clinical dietetics because hospitals get reimbursement for the diagnosis. Addressing malnutrition with the nutrition care of a dietitian is shown to prevent additional hospital costs, like patients having a longer length of hospital stay and medical complications (White et al., 2012). Dietitians are responsible for conducting the nutrition-focused physical exam, and without proper training and practice, malnutrition cases can be underdiagnosed resulting in preventable decline in patients' health (Tyler et al., 2020).

Communication skills

Gibson et al. (2016) measured communication skills such as rapport building, listening, effectively gathering verbal information, and involving the patient in the plan of care. The SP simulation, which was evaluated by trained assessors, found that students with lower skills at baseline improved the most. They did not include measurement of nutrition care skills.

Combination of Nutrition Care and Communication Skills

To my knowledge, only one study at the time of this writing measured both communication and nutrition care skills using SPs. Nutrition care and communication care skills were improved over multiple simulation events (Buchholz et al., 2020). No studies to date have measured both nutrition care and communication skills using evaluations of trained assessors and SPs over multiple simulation events, which is what the current study did.

Cost Considerations

While simulation certainly has benefits, programs must take cost into consideration for implementing simulation (Gaba, 2004). Simulation events that are described in this study required funds to pay for use of facilities and equipment, as well as the people involved in setting up the simulation experience. SPs are paid actors, which adds to the cost, especially if multiple SPs are included in each event. With more evidence supporting the use of simulation in dietetics training, programs will be able to advocate for funds for this advantageous learning tool, resulting in more knowledgeable and experienced dietitians in the healthcare system.

Role of ACEND® Standards in Dietetics Training

The Accreditation Council for Education in Nutrition and Dietetics (ACEND®) is "the accrediting agency for higher educational programming for those preparing to be registered dietitians" in the United States (*ACEND®*, 2021). The Coordinated Program in Dietetics at the

University of Missouri is accredited by ACEND® which means that the program follows specific guidelines and standards. Once program completion is verified, students become candidates and are eligible to sit for and pass a national examination administered by the Commission on Dietetic Registration – the credentialing agency for the Academy of Nutrition and Dietetics – to become a registered dietitian. In order to qualify for this examination, students also need to complete 1200 internship hours under the supervision of a registered dietitian. Coordinated programs, like the University of Missouri, include internship hours in the program. In contrast, there are didactic dietetics programs that only include the required didactic coursework. Students who have completed a didactic program are required to apply for internships to meet internship hours.

ACEND® develops the standards and competencies for the educational programs and requires all competencies be included and continuously assessed in the curriculum of each program. The competencies describe successfully demonstrating a specific skill; examples include collaborating with interprofessional teams, interpreting pertinent scientific literature, providing appropriate nutrition care, and communicating effectively. For the purposes of the current study, both nutrition care (CRDN 3.1) and communication (CRDN 3.3) competencies will be measured (*ACEND® accreditation standards: For nutrition and dietetics coordinated programs (CP)*, 2017). The description of these competencies is as follows:

> CRDN 3.1 – Perform the Nutrition Care Process and use standardized nutrition language for individuals, groups and populations of differing ages and health status, in a variety of settings.
>
> CRDN 3.3 – Demonstrate effective communications skills for clinical and customer services in a variety of formats and settings.

Because dietetics programming is competency-based in the United States, studies including ACEND® competencies as markers of skills and performance would expand knowledge regarding simulation use in dietetics training. Few other studies have objectively measured nutrition and communication skills using competency-based assessments. Buchholz et al. (2020) found improvements in nutrition-care and communication skills using competencies from the Partnership for Dietetic Education and Practice of the Dietitians of Canada. Tada et al. (2018) used competencies from Japan's Dietetic Association to evaluate the effect of simulation on self-efficacy of nutrition care. ACEND® competencies have been used to show benefit of using simulation for nutrition-focused physical exams (Schumacher et al., 2020; Tyler et al., 2020). By increasing use of ACEND® competencies as part of simulation evaluation among dietetics programs of the United States, clearer objectives can be established for simulations, leading to dietetics students more directly improving their skills.

Current Study

While research supports the use of simulation as a practical learning method, and the method is generally favored by learners, more research is needed documenting simulation use in dietetics programs for both nutrition care and communication skills. Additional evaluation would be useful about how simulation can facilitate learning in these areas, as well as improve performance of specific ACEND® competencies. With more data to support simulation in dietetics coursework using ACEND® competencies, simulation programming could be further developed to maximize students' performance assessment before going into the clinical setting. With this additional program development, simulations would better prepare students for entering the field as both a clinical student, and then as a registered dietitian professional. The

current study explored the use of simulation in the context of competency-based education in the field of dietetics with the following research questions:

1) Over two years of instruction, did the students improve competencies in nutrition care and communication (weight history, appetite/intake, NFPE, social and medical history interview) across three simulation events?
2) Were there differences in results between the two evaluator methods (Standard Patient, Faculty)?

Methods

Participants

Participants of this study were 40 students enrolled in the University of Missouri in Columbia, Missouri. They were part of the three-year Master's Coordinated Program in Dietetics from December 2016 to December 2020. Three cohorts of dietetic students participated in three simulation events. Each participant completed all three events in the same order: Fall of Year 1, Spring of Year 2, and Fall of Year 3. Each simulation was part of the coursework required for the program. The study was approved by University of Missouri Institutional Review Board.

Location

The simulation events occurred in the Sheldon Clinical Simulation Center, located in the MU School of Medicine in Columbia, Missouri. The standard patients (SPs) were human actors employed by the MU School of Medicine that were trained on how to be an SP by the staff of the Sheldon Clinical Simulation Center. The staff also provided the SPs a patient description and training for each simulation event. Several SPs were used for each event. The rooms were equipped to look identical to an inpatient (hospital) or outpatient (clinic) room. For example, the

rooms included hand sanitizer, a hand-washing sink, hospital beds, IV poles, etc. The simulation rooms include cameras and microphones to capture video and audio of the encounter. Attached to each room is a one-way mirror where evaluators can observe the interaction, as well as access the video and audio footage on computers. Figure 1 shows an example of the set up.

Figure 1

Sheldon Clinical Simulation Center, University of Missouri

Simulation Event Flow

The following describes a typical simulation event:

1. The SP was in the room ready for the event.
2. The student stood outside the door waiting for a bell that indicated the start of the encounter.
3. Once the bell sounded, the student walked in.
4. The student initiated the goal of the encounter (interview, education, etc.) as indicated for each event.
5. The bell indicated when 5 minutes was left – the student began to wrap up the encounter.
6. The bell indicated when the encounter was over, and the student walked out.

Simulation Event Description

Three events were included in this study. Table 3 describes the events. Events were designed to test more advanced knowledge and skills across time, Event 3 being the most advanced simulation.

Table 3

Simulation events of current study

Event	1	2	3
Course	Nutrition 3360: Nutrition Assessment SPE[1]	NEP 3370: MNT[2] I SPE	Nutrition 7381: MNT[2] II SPE
Time in program	Practical Final of Year 1: Fall	Practical Final of Year 2: Spring	Practical Final of Year 3: Fall
Simulation type	SP	SP	SP, high-fidelity simulator
Time of patient encounter	15 minutes	20 minutes	15 minutes
Nutrition topic	Nutrition assessment, malnutrition	Nutrition assessment, MNT intervention	Nutrition assessment, MNT intervention
ACEND® competencies	CRDN 3.1, 3.3	CRDN 3.1, 3.3	CRDN 3.1, 3.3
Source from which evaluation items were adapted	Ohio State	Medical Nutrition Therapy Simulations, First Edition	Medical Nutrition Therapy Simulations, First Edition

Note. [1]SPE – Supervised Practice Experience, [2]MNT – Medical Nutrition Therapy

Each simulation was part of the nutrition course's practical final and included a nutrition assessment and communication component. The ACEND® competencies being measured were CRDN 3.1 – *Perform the Nutrition Care Process and use standardized nutrition language for individuals, groups, and populations of differing ages and health status, in a variety of settings*; and CRDN 3.3 – *Demonstrate effective communication skills for clinical and customer services in a variety of formats and settings*. Event 1 was a 15-minute simulation with an SP that was a patient exhibiting symptoms of malnutrition. Event 2 was a 20-minute simulation with an SP that needed a disease-specific medical nutrition therapy education (e.g. type II diabetes). Event 3

included both a human actor as the "nurse" as well as a high-fidelity simulator with live responses from faculty over the loudspeaker. The student was supposed to communicate with both the nurse and patient to get the information needed. The high-fidelity simulator only answered "yes" or "no," so the student needed to ask the nurse for detailed information about the patient.

Simulation Event Evaluations

Video and audio recordings, as well as the blank evaluation forms, were available through Learning Space, a computer software specializing in simulation for clinical education. Evaluations were completed by a faculty evaluator, the SP, and the student. The faculty observed the encounter behind a one-way mirror in addition to having access to the audio and video recording to complete their evaluation (Figure 1). The SP completed the evaluation promptly after the encounter. Students were required to complete a self-evaluation within one week of their recorded performance as part of their grade. Evaluations measured nutrition care and communication skills, however, they were not always worded the same between each evaluator. The SP evaluator items were directly related to them, such as "Student asked about my usual weight and any weight changes." Faculty answered more complex evaluation items, such as "Determined usual body weight (140 lbs.)," checking the number for accuracy. While worded differently, both evaluation items were examples of a nutrition care skill. Some SP evaluations included communication skills that were not also evaluated by the faculty and student, such as "During the interview, the student made me feel comfortable and relaxed." Evaluation questions were scored either 0 or 1: 0 = did not meet competency; 1 = competency met. Table 4 shows sample items from the SP evaluation:

Table 4

Sample SP evaluation ratings

	Did not meet competency	Competency met
Student asked about my usual weight and any weight changes.	0	1
Student asked about my appetite and appetite changes.	0	1
During the interview, the student made me feel comfortable and relaxed	0	1

Data Analysis

Evaluations were documented in Learning Space and on paper. Data were combined using Microsoft Excel. All items were modified to a 0-1 scale: 0 – competency not met, 1 – competency met. Competencies are entry-level competencies, which focus on preparation and evaluation for minimum competence upon completion of an ACEND® education program. Evaluation items were divided into 2 groups: 1) nutrition care skills and 2) communication skills. For each student, each group of items was averaged for each event. Students with missing data were excluded for the purpose of data analysis. All statistical analyses were run in R. A repeated-measures *ANOVA* technique was used to measure SP and faculty evaluation changes in nutrition care across the three events. Normality was assessed using Shapiro-Wilk tests. Follow up *ANOVA* procedures used the post-hoc Bonferroni test. Interactions between event and evaluator were also assessed using a repeated-measures *ANOVA*. All analysis tested significance as $p < 0.05$ except when additional adjustments were indicated. Results in Table 5 are reported as percentages of total competencies met.

Results

Table 5 shows a summary of the results for nutrition care and communication measurements. Students were scored 0 or 1 for each evaluation item (0 = did not meet competency, 1 = competency met). Items were averaged for each student evaluating both nutrition care (NC) and communication (Comm). Average scores are reported as percentages which reflect the average percentage of items that the students met for the competency of each event. Standard deviations are in parenthesis. *ANOVA* significance of each is indicated on the right.

Table 5

Results

		Competency items met % (SD)			*ANOVA*
Evaluation	Measurement	Event 1	Event 2	Event 3	
SP[1]	NC[2]	74.2(18)	77.6(21)	79.4(23)	$p = 0.054$
Faculty	NC	73.9(20)	85.5(19)	78.6(27)	$p = 0.067$
SP	Comm[3]	93.5(13)	90.2(9)	88.7(24)	$p = 0.356$
	Note. [1]SP – Standard patient; [2]NC – Nutrition Care; [3]Comm - Communication				

Nutrition Care Competencies

For nutrition care SP evaluation, some concerns for normality were noted. No concerns were noted for sphericity. The SP ratings improved among participants across time with nearing significance, $F(2,78) = 0.62$, $p = 0.054$, with a small effect size ($\eta^2 = 0.01$). Follow-up post hoc procedures with the Bonferroni test found that there were no significant differences between Event 1 and 3 ($p = 0.076$), between Event 1 and 2 ($p = 1.00$), or Event 2 and 3 ($p = 1.00$).

For the faculty evaluator method, concerns for normality and sphericity were observed. No significant differences were observed, $F(2,78) = 2.8$, $p = 0.067$, with a small effect size ($\eta^2 = .04$).

Communication Competencies

For the SP evaluator method, concerns for normality and sphericity were observed. No significant differences were observed for communication scores, $F(2,78) = 1.05$, $p = 0.356$, with a small effect size ($\eta^2 = 0.015$).

Interaction Among Evaluators

No significant interaction was found between event and evaluator $F(2,78) = 1.6$, $p = 0.207$, with a small effect size ($\eta^2 = 0.01$), which indicates evaluator scores were not graded significantly different between the SP and the faculty. Concerns for normality were observed. No concerns were observed for sphericity.

Discussion

Simulation is an increasingly popular and useful method of teaching among dietetics programs. As more is discovered about how simulation can help meet competencies required by dietetics programs, simulation can be implemented more strategically to increase students' learning and performance. Dietetic preceptors, who are registered dietitians available and willing to train and supervise dietetic students in the clinical setting, are limited across the United States (Crayton, 2016). This is a problem because if students do not get hands-on experience in the clinical setting with quality feedback, they cannot prepare appropriately for taking the registered dietitian exam or starting their career as an entry-level dietitian.

The objective of this study was to assess measures among dietetic students across three simulation events using multiple evaluator methods and the ACEND® competencies in order to test if simulation identified improvements in nutrition care and communication across time.

Table 5 shows results across the 3 events for the following evaluations: SP Nutrition Care, Faculty Nutrition Care, and SP Communication. Examples of nutrition care include nutrition-focused physical exam, weight history, dietary recall, and gastrointestinal symptoms. Examples of communication skills include listening to the patient, making the patient comfortable with the student's presence, and providing a distinct beginning/middle/end to the session. Nutrition care scores improved across the three events according to SP evaluations (p = 0.054), and the faculty evaluations (p = 0.067) with nearing significance. No significant changes occurred among SP communication scores across the three events.

Nutrition Care

For nutrition care evaluated by SPs, the percentage of competencies was increased across each of the three events with nearing significance (p = 0.054). There was a increase between Event 1 (74%) and Event 2 (78%), and then a slight increase from Event 2 to Event 3 (79%). Overall, they met more nutrition care competencies as they progressed to each event, showing they demonstrated more nutrition care skills over time.

For nutrition care evaluated by faculty, the percentage of competencies was increased from Event 1 (74%) to Event 2 (86%), and then decreased slightly from Event 2 to Event 3 (79%). Students on average met the most nutrition care competencies during Event 2. Students increased competencies from Event 1 to Event 3, showing they demonstrated more nutrition skills over time.

It is important to note that while the SP evaluations and faculty evaluations of nutrition care were nearing significance, they did not meet the significance criteria of $p < 0.05$, which means that the improvements could have occurred by chance. Additional research is needed to confirm these findings.

The nutrition care scoring results are consistent with findings from Hawker et al. (2010) and Bushholz et al. (2020), whose studies both showed a significant improvement in nutrition care across simulations. The study by Hawker et al. demonstrated a positive significant correlation between score during simulation and students' clinical evaluations after starting clinical rotations, indicating simulation can better prepare students for entering the clinical setting as opposed to no simulation use. Buchholz demonstrated nutrition care scores improved over two simulation events. Results of the current study align with the nutrition care results found in the literature.

Communication

According to the SP evaluation, students met more communication competencies on all three events than any other event measuring nutrition care competencies, with students meeting an average of 94% of the communication competencies on the first event. Percentage of communication competencies stayed high (90% for Event 2, and 89% for Event 3). Students in this study demonstrated the highest ability in communication skills compared to nutrition care skills.

Differences between communication skills across the three events per the SP evaluation were not significant. These findings are difficult to compare to the past literature because only two studies (Buchholz et al., 2020; Gibson & Davidson, 2016) investigated change in communication skills directly, whereas the other studies only measured perception of skill.

Gibson et al. found significant differences in communication skill between two events that were two weeks apart, with improvement especially among students who had low scores initially. The students in the current study had high communication scores to start, so this may be why similar results were not observed. Similarly, Buchholz et al. (2020) also showed significant changes in communication skills among students, with events occurring within the same semester. The current study's three events occurred several semesters apart from each other, which may have made it difficult to observe quantifiable changes in these communication skills, or "soft skills", that are so important in this field.

Typically, students training to be dietitians have been required to demonstrate "soft skills" already before beginning their professional program. Communicating effectively is a widely recognized and necessary skill for registered dietitians because it is the first step of accomplishing most other clinical goals. To obtain any type of patient history, or even collaborate with other clinicians related to nutrition care (physicians, social workers, etc.) sufficient communication skills are crucial. While it can be assumed students in the program improve these skills over time, the communication skills that are isolated from nutrition care during the simulation (i.e. "Student seemed interested/concerned about my problem), might already be a skill the student is maintaining, rather than improving at the time of the evaluation in this study. In fact, the communication scores decreased slightly over time, which was not significant, but could illustrate the increased cognitive challenge of each event. As the student progresses in the professional program and thus, simulation events, the events become more difficult. While the students' nutrition care skills improved significantly over time per the SP evaluation, the slight decrease communication skills could indicate the shift of focus from the

communication skill that the student already had demonstrated in Event 1, to the implementation of adding the nutrition care skill that progressed in difficulty.

It was expected that students would meet more competency items across time for several reasons. The students improve their knowledge about what to expect during a simulation event as they participate in multiple events. After they participate in the first event, they will have a better idea of what to expect for the second. Not only do the faculty of the program debrief the simulation experiences after they are completed, but the students were required to observe and evaluate themselves after each event. The students also receive the feedback from the faculty evaluator and can use that knowledge in the next simulation event. This is one benefit of simulation – the faculty can observe the student directly and provide specific and timely feedback while the student is truly "in action." Simulation makes this type of feedback much more feasible than a classroom or clinical setting. Because students have the opportunity to receive this feedback, they can be more prepared and confident with their nutrition care skills when they enter clinical rotations. Similarly, dietetic preceptors do not always have the time to observe the student with every patient interaction. Simulation can help students practice and observe themselves performing specific skills. With the combination of each method of evaluation (SP, faculty, and self), students can make a plan of action to improve the recommended skills before seeing real patients.

The demonstration of nutrition care skill improvement across events due to exposure can mimic the improvements as students develop their skills in the clinical setting. While the change was not significant, the close to significant improvement in nutrition care skills observed in the current study is an indication that simulation might be helping the students to practice and refine

skills even before entering their clinical rotations – showing how simulation can prepare students in a way that other educational tools cannot.

Results indicated there was no significant interaction between the events and the evaluators, meaning that the SP and faculty evaluators did not evaluate the events significantly different compared to each other across time for the nutrition care competencies. Figure 5 shows students met less competencies according to the SP for Event 2 (78%) compared to faculty (86%), but scores were the same for Event 1 and Event 3 (74% and 79%, respectively).

While not significant, the differences between evaluators were not surprising for several reasons. The evaluators both assessed the same nutrition skills, but received a different series of evaluation items. In Event 2 an item for the SP was "Student asked about my usual intake in more detail", while for the same event, the faculty's item was "Completed evaluation of the diet." For Event 2, the SP had more nutrition care items than the faculty, such as "Student discussed my ability to cook, travel to the grocery and food store appropriately" and "Student discussed my ability to purchase food" which were not included in the faculty evaluation. Additionally, the faculty and SP provide different perspectives for the evaluation. The faculty are nutrition experts who are well-versed in the specific skills that they are evaluating, while the SPs are coming from an outside perspective that likely do not know of the expectations of the student's performance. The faculty know the students personally, which could introduce bias, while the SP is coming to the evaluation without potential bias due to knowing the student.

Because the simulation events were not originally created for research purposes, the evaluations were not set up to collect completely identical information. The faculty of the program use both the SP and faculty evaluations to determine the students' academic grades for the simulations. The students are also responsible for reviewing the faculty and SP evaluation

for feedback on their performance. Due to the difference in detail of the evaluations, it makes sense that there were differences among the evaluators. The variability of items between evaluators is an advantage to the student – it provides a more comprehensive evaluation for teaching purposes than if they were completely identical evaluations. On the other hand, the disadvantage of differences between evaluator methods is that they cannot serve as a means of quality control for the evaluation. For Event 2 nutrition care, while not statistically significant, the SP scores were lower than the faculty scores, and it cannot be determined if this is because (1) the evaluations themselves are different, (2) evaluators graded harder than another, and/or (3) there was human error or bias. More research is needed with a larger data set to further investigate the relationship between SP and faculty evaluators in dietetics simulation.

Limitations

There were a few limitations within this study. This was a rather small sample size of 40 students, which is similar to previous studies. Research is needed with greater sample sizes. The three events were not originally set up for research purposes, so a few modifications were made for the purpose of the study design. Nutrition care and communication evaluation items were not identical across each event for each evaluator, nor were they tested for validity or reliability. For the purpose of the study, items were categorized by this author to either nutrition care or communication, and then scores were averaged, so that they could be compared across the three events. Evaluations with valid, reliable, and consistent measures for each consecutive event would improve the quality to confirm similar results.

A control group was not included in this study. Since the benefit of simulation is clear, it would be unethical to deny a group of dietetic students in their professional program the unique opportunity of simulation as part of their education. For this reason, it would be impractical to

implement a control group for research purposes. Results from the first event serve as the baseline for this experiment, and therefore also serve as the control.

Without a formal control group, it cannot be confirmed that improvements were from the use of simulation alone. Dietetic students met more competencies in nutrition care through all simulation events and it is unknown if this is because the simulations themselves helped the student learn more for the next event, or if the quality feedback provided in the first event allowed for this improvement in performance. The events in this study occurred semesters apart from each other, and while simulation as an educational tool could have contributed to these improvements, the students were also learning and practicing many relevant skills in the time between events. Because these students were part of the coordinated program, they also completed clinical hours in between the events. It would be difficult and impractical to test the effect of simulation alone alongside a coordinated program in dietetics due to the nature of the integrated coursework and internship hours.

Conclusion

Two main benefits of simulation are identified in the current study: (1) simulation can be a learning tool for nutrition care and communication skills, and (2) it provides a controlled and quality method of evaluating competencies in dietetic students.

In this small sample of students enrolled in the MU Coordinated Program in Dietetics, an improvement in nutrition care competencies was found across time with nearing statistical significance. Simulation allows dietetics programs to evaluate students using the ACEND® competencies, which is an efficient way to assess student learning and development at a critical time in the students' progression through their professional program. Meeting each ACEND® competency must be documented for each student in dietetics programs, and simulation can

provide an organized and clear method of this requirement. Simulation in dietetics students can be a useful training method by demonstrating skill improvement across time and providing opportunity for quality feedback. It allows students to practice pertinent nutrition skills that are impactful long term in a variety of professional settings. If the resources are available, programs should take advantage of this tool for the greatest benefit for the success of the dietetics student. Incorporating simulation in dietetics training results in improved educational and clinical outcomes.

Future Directions and Implications

Going forward, more research would be beneficial to confirm the current findings in this study. The following questions summarize directions for future simulation research.

How do we develop validated tools alongside ACEND® competencies for simulation evaluations in order to conduct more rigorous data collection across multiple simulation events?

Much of the research on simulation in dietetics available uses data taken from simulation events meant for curriculum purposes. While this is a start, simulation experiments developed specifically for research purposes using ACEND® competencies would allow for increased rigor. Reliable and validated tools should be used to create higher quality and more consistent data, which would add insight to the impact of simulation as a method of meeting ACEND® competencies.

What is the ideal time frame between events to conduct simulation evaluations in order to detect skill differences among the events?

Time between events vary among the studies currently available in the literature. Of the studies discussed, many reported differences between events occurring within weeks of each

other. The timeline of the current study involved three events occurring over multiple academic semesters – resulting in over a year passing between the first event and the second event, and two years between the first to the third event. A study involving variability in timing, such as simulation events at baseline, post-one month, post-three months, and post-one year, would allow for comparison of differences in scoring among short-term and long-term changes from baseline. Currently, it is unknown how long it takes to see significant improvement of nutrition skills using simulation. If research could identify the ideal time to test these improvements, dietetics programs could be more strategic in how often to implement simulation in coursework. Knowing this could save time and resources.

How often is simulation indicated before students begin clinical rotations or while during participation in clinical rotations?

For the purposes of preparing students for the clinical setting, it is unknown how close to implement simulation events before entry into the clinical setting for dietetic students to receive the maximum benefit. On one hand, participating in simulation events further away from clinical rotations, such as more than one month, could provide time for the student to process feedback and practice skills. Alternatively, participating in simulation closer to entering the clinical setting could allow the student an opportunity to implement feedback right away that was obtained from the simulation.

Is the current evidence enough to indicate allocating resources to implementing simulation among dietetics programs?

As significant improvements were observed across simulation events, it is unknown what specific variables contributed to these improvements. The improvements could have been due to a combination of (1) the benefit of simulation as a learning experience and (2) that simulation

provides an opportunity for high quality feedback from faculty. Regardless of what extent each contributes, previous research has shown that simulation can prepare students for entering the clinical setting and work force, improve nutrition care competencies, and allow for high-quality feedback from multiple evaluators (SP, faculty, self, peers). The current study confirmed simulation can be used as an evaluator method and means for meeting ACEND® competencies.

In conclusion, simulation is an innovative and applicable educational tool to use in dietetics training. Future research can help further establish how to use simulation most strategically with consideration of available resources. Exploring the above questions about simulation in dietetics will advance the dietetics profession by creating improved methods for meeting ACEND® competencies, expanding the skill set of entry-level registered dietitians, and thus, expanding the credibility of these valuable professionals. Because registered dietitians are experts in nutrition-related tasks essential for improved clinical results, use of simulation is the paramount future to improve health outcomes of all people.

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