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Engaging Middle School Students and Parents/Guardians via Structured Virtual Media on Food Allergy and Anaphylaxis Awareness: A Quality Improvement Project

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Engaging Middle School Students and Parents/Guardians Via Structured Virtual Media on Food Allergy and Anaphylaxis Awareness:

A Quality Improvement Project

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Comments: I reviewed this manuscript and I approve it to be submitted as the DNP Program requirement.

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Abstract

Background and Significance: More than 40% of children with food allergies have experienced anaphylaxis, a life-threatening condition (Food Allergy Research & Education [FARE®], 2021). Anaphylactic reactions require immediate treatment with an intramuscular injection of epinephrine by a health care professional or by a self-injectable epinephrine auto-injector device. If anaphylactic symptoms are not promptly recognized and treated, fatal consequences may occur (FARE®, 2021). Repeated education, training, and a supportive social environment specifically with adolescents have been found to facilitate self-management with food-induced anaphylaxis (Comberiati et al., 2019). **Purpose:** In this quality improvement project virtual education interventions to increase food allergy and anaphylaxis knowledge and confidence levels among 8th-grade students and parents/guardians were presented using the Food Allergy Research & Education (FARE®) website. **Intervention and Implementation Plan:** The development and implementation of a two-week virtual classroom focused on education derived from the FARE® organization targeting 8th-grade students and parents/guardians. A pre-and post-education questionnaire was administered to participants assessing both knowledge and confidence relative to food allergies and anaphylaxis. In addition, a focus group was conducted assessing student perception of the virtual classroom program benefits. **Results and Implications:** The means of the pre-and post-knowledge education scores showed meaningful improvement ($t = 8.18$, $p < .001$) with a large Cohen's d effect size 1.13 (95% CI [0.781,1.48]. The means of the pre-and post-confidence scores also showed improvement ($t = 8.68$, $p < .001$) with a large Cohen's d effect size 1.20 (95% CI [0.843,1.56]. The results of the focus group revealed that students found the program beneficial. Implications for nursing practice include bringing evidence-based practice to the school community, enhancing interprofessional

collaboration among educators, certified school nurses, students, and parents/guardians aligning with the Centers for Disease Control and Prevention (2020) Guidelines for Healthy Schools.

Keywords: Epinephrine, epinephrine auto-injector, food allergies, nut allergies, anaphylaxis, and fear

Engaging Middle School Students and Parents/Guardians Via Structured Virtual Media on Food Allergy and Anaphylaxis Awareness: A Quality Improvement Project

Nearly six million children have food allergies (FARE®, 2021). The most common food allergens include peanut, milk, shellfish, and tree nuts in children (FARE®, 2021). The Food Allergy Research & Education (FARE®, 2021) organization defines a food allergy as "an adverse health effect resulting from a specific immune response that occurs reproducibly on exposure to a given food." Food-induced anaphylaxis is a severe allergic reaction (e.g., difficulty breathing, throat/mouth swelling, repetitive vomiting etc.) that is sudden in onset and may be fatal if not treated promptly (FARE®, 2021). Peanut and tree nut allergies tripled between 1997-2008 (FARE®, 2021).

Epinephrine auto-injector (EAI) devices are life-saving medications; however, knowledge, confidence, and fear with use significantly impact efficacy. Antihistamines, steroids, and asthma medications are essential treatment options for mild allergy symptoms or in conjunction with other disease processes. These medications above, however, cannot substitute administration of intramuscular epinephrine or an EAI into the vastus lateralis muscle; a common misconception among children, adults, and even healthcare providers (FARE®, 2021; Prince et al., 2018). Prince et al. (2018) identified several mutual themes for delays in EAI administration, a patient or parent "not thinking it was necessary, fear of using it, or having an expired device" (p. 141). Dang and Dearholt (2017) describe problems that are important to explore are those that can cause harm. The delay in EAI administration during an episode of anaphylaxis may cause harm or, worse, death. Robinson et al. (2017) found that two-thirds of

patients presenting to pediatric emergency rooms with anaphylaxis did not receive epinephrine before arrival (Prince et al., 2018).

Currently, there is no cure for food allergies, but ongoing research is promising. The avoidance of food triggers remains the only absolute way to prevent mild or severe reactions. Teenagers and young adults are at the highest risk of fatal food-induced anaphylaxis. The majority of reactions in teenagers occur outside of the home, where food intake supervision is less, and EAIs are either unavailable or misused (FARE®, 2021). Food-related anaphylaxis is common; however, fatalities remain low, ranging from 0.03 to 0.3 deaths per million person-years (Turner et al., 2017). Nevertheless, children and families afflicted by food allergies constantly fear this risk.

The Centers for Disease Control and Prevention, the US Department of Education, and several federal agencies set guidelines for schools to address the food allergy epidemic stating (1) educate all children and family members about food allergies and (2) create and maintain a healthy and safe educational environment (Centers for Disease Control and Prevention [CDC], 2020). Still, these recommended guidelines have been inconsistently used. Minimal instruction is delivered from the community, including schools where food allergy reactions are increasingly common. Two children in every classroom are diagnosed with a food allergy and often initially present at school (FARE®, 2021). It is crucial with the rising food allergy incidence and pediatric hospitalizations that allergists, emergency room physicians, pediatricians, and the school community work together to cohesively find ways to educate children and families with food allergies.

Identification of Problem

The clinical problem is twofold: Inconsistency and delay in using an EAI device during anaphylactic food allergy emergencies compounded by varying education provided to children and families regarding symptom recognition and prompt treatment. Therefore, the DNP student planned to address these problems in a Doctorate of Nursing Practice (DNP) quality improvement project. The implementation of this project is vital in preventing further fatal food allergy events.

Literature Review

An extensive literature search was conducted reviewing both quantitative and qualitative research articles regarding child and adolescent food allergies and anaphylaxis. Over 60 articles, including systematic reviews, were evaluated from PubMed, ProQuest, CINAHL, Embase, and Google Scholar. Twelve studies were selected to be reviewed and were categorized as either Level I, Level II, or Level III evidence. Initial key search terms included: Epinephrine, epinephrine auto-injector, food allergies, nut allergies, anaphylaxis, and fear. Literature searches were limited to seven years. Identification of key concepts and similar themes noted in the literature synthesis include: (a) Delay in EAI device use, (b) variability of training and education with an EAI device leading to misuse, (c) lack of knowledge and confidence with an EAI device administration technique, and (d) barriers to device design impacting carriage and ease of use.

Delay in EAI Use

Fromer (2016) identified in multiple studies that the prompt treatment and recognition of anaphylactic symptoms are inadequate, further contributing to the economic burden of this chronic illness. Likewise, patients lack adherence to carrying the recommended two EAI devices related to device structure and high prescription medication costs (Fromer, 2016). Prince et al. (2018) noted that ER physicians often prescribe antihistamines and corticosteroids first to

patients presenting with anaphylaxis instead of epinephrine. Thus, creating further contradictions and confusion with patients and families understanding appropriate first-line treatment when severe allergic reactions occur at home.

Variability of Training and Education with an EAI Leading to Misuse

Brockow et al. (2015) found that structured patient education programs may help increase patients' empowerment to prevent and treat anaphylaxis. Gallagher et al. (2019) found that implementing a decision support application on a smartphone can improve anaphylaxis recognition and increase choosing appropriate treatment. Chooniedass et al. (2017) note "the need for healthcare professionals to address, educate and prepare patients for the myriad of emotions, thoughts and behavioral responses that are encountered when parents live with children with food allergies" is crucial (p.8). Patient interviews from the study yielded eight main themes: Perception of anaphylaxis, life challenges, isolation, anxiety, hesitation, guilt, the influence of healthcare professionals, and lessons learned (Chooniedass et al., 2017). Inconsistency and inaccuracy with food allergy and anaphylaxis instruction often occur in emergency rooms, allergy clinics, and pediatrician offices where patients and families seek healthcare provider expertise (Prince et al., 2018).

Lack of Knowledge and Confidence with EAI Administration Techniques Leads to Misuse

Shemesh et al. (2017) describe that practice with self-injection with an empty syringe in a clinic setting improves adolescents' and parents' comfort level with self-injecting. Prince et al. (2018) identified that patients and physicians fail to administer epinephrine despite availability relative to knowledge and comfort with correct administration, further contributing to misuse during anaphylaxis. El Turki et al. (2017) found that children and parents/caregivers lacked correct administration techniques when using EAI devices; likewise, healthcare professionals

were also described as having deficiencies with knowledge of proper EAI device administration techniques.

Barriers to Device Design Impacts Carriage and Ease of Use

Portnoy et al. (2019) describe "real-world differences" in patients' carrying time, confidence in use, and training experiences between two different EAI devices, Auvi-Q® and EpiPen®. Leach et al. (2018) share seven major themes regarding adolescent preferences with the design of EAI devices which include: Accessibility and carriage, comprehensibility of instructions, indication of correct administration, safety, speed of administration, visibility and identification, and precise drug delivery (Leach et al., 2018). Kessler et al. (2019) found that untrained adults preferred the Auvi-Q® over the EpiPen Jr.® based on device design during simulated scenarios. Umasunthar et al. (2015) found adrenalin (epinephrine) auto-injector device design is a major factor in successful administration. Success rates were highest using the voice prompt device Auvi-Q®. Suwan et al. (2018) note that a prefilled epinephrine syringe is "significantly easier to use with a higher rate of correct use compared to EpiPen® over time" (p. 248).

More consistent teaching is needed for patients, families, and healthcare providers about proper EAI device use during anaphylactic emergencies (Prince et al., 2018). In the literature, many studies addressed education programs, but zero captured the potential of school health as a catalyst for change. This gap in evidence provided a great opportunity for the DNP student to facilitate and lead change in one school community. Through reputable education resources (FARE®) and innovative virtual teaching methods (virtual classroom), 8th-grade students and

parents/guardians are expected to have significant improvements in knowledge and confidence and greater awareness about food allergies and anaphylaxis as a result of this QI project.

Theoretical Frameworks

Institute of Healthcare Improvement (IHI) Model for Improvement

The IHI Model for Improvement was chosen as the Framework for this DNP project because it emphasizes the acceleration for quality improvement in healthcare processes (Institute for Healthcare Improvement [IHI], 2021). Central elements of the IHI Model for Improvement are to develop, test, and implement changes in individuals (students), groups (middle school), or organizations (school district) (IHI, 2021). The IHI Model for Improvement has two distinct parts. The first part asks three fundamental questions (1) What are we trying to accomplish? (2) How will we know that a change is an improvement? (3) What change can we make that will result in improvement? The second part includes the Plan-Do-Study-Act (PDSA) cycle (Appendix A: PDSA Cycle). This method was valuable as this education was new for 8th-grade students and parents/guardians within the school district. The IHI Model for Improvement process includes: Forming the team, setting aims, establishing measures, selecting changes, testing changes, implementing changes, and spreading changes (IHI, 2021). Using this conceptual model to guide and tailor the virtual classroom project was crucial for obtaining initial support from the school district and developing sustainability processes in the health curriculum for both the Certified School Nurses (CSN) and the Physical Education/Health Teachers. The PDSA cycle provides structure and clarity within organizations to implement well-constructed analytical projects (McBride & Tietze, 2019). This DNP project, including aims, objectives, outcomes, and the implementation plan, was formally presented to key

stakeholders in the school district (Director of Curriculum, Assessment & Professional Development, Director of Student Services, Principal, Vice-Principal, and Physical Education/Health Teachers) in May 2020.

Framework for 21st Century School Nursing Practice™

The Framework for 21st Century School Nursing Practice™ (Appendix B: NASN Framework) was also chosen to guide this DNP project because it aligns with the Whole School, Whole Community, Whole Child Model that calls for a collaborative approach to learning and health (ASCD & CDC, 2014). This Framework includes five fundamental principles that school nurses must include to meet the needs of the students (1) Care Coordination, (2) Leadership, (3) Quality Improvement, (4) Public Health, and (5) Standards of Practice (National Association of School Nurses [NASN], 2020). The principle of Quality Improvement is imperative as it provides consistency in improving and building evidence-based practice in school nursing. The Framework for 21st Century School Nursing Practice™ encompasses health education, collaboration communication, risk reduction, and quality improvement. It supports implementing a virtual classroom focused on food allergy and anaphylaxis education for 8th-grade students and parents/guardians. Permission was obtained to use this Framework throughout the DNP project (Appendix C: NASN Permission).

Sociotechnical Model: Actor-Network Theory

The Actor-Network Theory (ANT) is a theoretical framework that encourages practitioners and researchers to explore the concept that all things in the environment are individual actors (e.g., students) and have the capacity to affect and modify any given situation that is interconnected (e.g., computers) (McBride & Tietze, 2019). ANT explores the link between humans and non-humans and describes people and objects as the actor-network, which are

mutually influential using the sociotechnical perspective in organizational decisions and practice (Desai et al., 2017). Because the DNP project was completely virtual related to the Covid-19 restrictions understanding this theory and its application in the development and implementation of education to 8th-grade students and parents/guardians were vital in delivering a successful project while recognizing its overarching impact.

Project Purpose

The purpose of this DNP quality improvement project was to assess, implement, and evaluate if consistent virtual classroom education interventions increase food allergy and anaphylaxis knowledge and confidence levels among participants using the Food Allergy Research Education FARE® website (Appendix D: FARE® Permission). The FARE® organization "enhances the lives of individuals with food allergies empowering them to lead safe, productive lives with the respect of others through education and advocacy initiatives and improved awareness around healthcare options and treatment (FARE®, 2021). This DNP project aims to bring a greater understanding of the food allergy epidemic affecting nearly six million children and adolescents in the U.S. and, more specifically, the school community (FARE®, 2021). Using the Johns Hopkins Nursing Evidence-Based Practice Model (Dang & Dearholt, 2018), a PICOT question was framed: Does engaging middle school students and parents/guardians via structured virtual media (virtual classroom) increase knowledge and confidence in food allergies and anaphylaxis awareness?

PICOT

The population (P) for the project was 8th-grade middle school students and parents/guardians (participants). The intervention (I) was developing and implementing a virtual classroom to engage participants regarding food allergies and anaphylaxis. Additionally, a focus

group was offered for participants that signed the Statement of Participation (see Appendix E) permission form. The comparison (C) was baseline knowledge and confidence with food allergies and anaphylaxis. The outcome (O) was improved knowledge and confidence after participation in the virtual classroom. The timeline (T) for the project included a two-week virtual classroom with a pre-and post-education knowledge and confidence questionnaire administered.

DNP Project Aims and Objectives

Aim #1: To assess the need to develop a virtual classroom program focused on food allergy and anaphylaxis education for 8th-grade students and parents/guardians.

Objective #1: Identify and evaluate anaphylactic cases in the middle school and within the school district (over three years).

Objective #2: Evaluate the incidence and prevalence of food allergies in the middle school and within the school district (over three years).

Aim #2: To implement virtual classroom teaching modules for 8th-grade students and parents/guardians using the Food Allergy Research & Education (FARE®) resources.

Objective #1: Provide the opportunity for all 8th-grade students and parents/guardians in the middle school to participate in food allergy and anaphylaxis education through virtual media.

Objective #2: Implement virtual classroom teaching modules for all 8th-grade students and parents/guardians using the FARE® resources via Blackboard Collaborate.

Aim #3: To evaluate the virtual classroom teaching modules effectiveness for 8th-grade students and parents/guardians using the FARE® resources.

Objective #1: Evaluate the pre-and post- knowledge and confidence measurement tool for 8th-grade students.

Objective #2: Evaluate the focus group for 8th-grade students post- virtual classroom teaching modules evaluating qualitative data regarding the program curriculum and educational resources using thematic analysis.

Aim #4: To provide a sustainable plan within the school community to increase knowledge and confidence levels regarding food allergies and anaphylaxis using the FARE® resources.

Objective #1: Food allergy and anaphylaxis virtual classroom teaching modules can be sustained, applied, and further implemented in other grade levels within the school district through collaboration with Certified School Nurses and Health/Physical Education Teachers to be included in the academic curriculum.

Methodology

The project site is a large, suburban public school district located in Pennsylvania. The school district comprises seven elementary schools, three middle schools, one intermediate high school, and one senior high school. The project was implemented in one of the three middle schools where the residency preceptor is the Certified School Nurse (CSN) and Chairperson of the Health Services Department. Currently, the school district serves nearly 9,000 students, and of those, 1,463 have documented food allergies (Appendix F: School District Statistics). Participants for this quality improvement project were limited to one middle school and focused on 8th-grade students and their parents/guardians. All participants (8th-grade students and parents/guardians) were asked to voluntarily sign a Statement of Participation (see Appendix E)

to be part of the QI project, which granted permission to use the data from the study interventions.

Project Approval

Preliminary project approval was established by the school district in May 2020, with the Certified School Nurse as the primary residency preceptor and liaison for the project. Duquesne University's IRB approved (Appendix G: IRB Approval) this DNP project and all the submitted documents (including formal written permission from the school district, permission to reproduce information from FARE® [see Appendix D], Statement of Participation [see Appendix E] permission for students and parents/guardians, and pre-and post-knowledge and confidence questionnaires [see Appendix H]). All email correspondence for 8th-grade students and parents/guardians was through the CSN. Data was kept confidential, students were deidentified, and all information was kept in a locked drawer or secured email files in the school health office.

Categorizing and Monetization of the Costs and Benefits of the DNP Project

McDavid et al. (2019) note that Cost-Benefit Analyses (CBA) are "conducted to estimate the value or relative value of an intervention to society" (p. 308). It was important for key stakeholders (e.g., school administrators) to understand this DNP project's economic and societal impact. The project costs include meeting with the key stakeholders, time with students and parents/guardians, and a participation incentive for joining the focus group ($25 gift card raffled to one participant by the CSN), which totaled $455.00. The tangible benefits of increasing knowledge and confidence related to anaphylaxis education for 8th-grade students and parents/guardians include cost-savings relative to ER visits, hospital and intensive care unit

admissions, ambulance transports, additional allergist visits, and medications used as a result of anaphylaxis for one patient totaling $27,227. The intangible benefits include increased awareness, knowledge, recognition, improved confidence, reduced fear and anxiety, increased student/parent satisfaction, improved relationships with the school district, increased community support, and decreased risk of anaphylaxis or death. The cost-benefit ratio of 61% supported the implementation of this project within the school district. Providing educational interventions to 8th-grade students and parents/guardians in this DNP project will likely produce very positive outcomes with minimal cost. The potential benefit of saving a student's life with increased knowledge and confidence is priceless.

Interventions

In collaboration with the CSN, the Physical Education/Health Teachers, and the Informational Technology (IT) Liaison for the middle school, it was decided that virtual education would be implemented during Health classes because of Covid-19 restrictions. The virtual education was provided on January 6, 2021, and January 13, 2021, via Blackboard Collaborate (computer software technology equipped for live and recorded virtual sessions). The DNP student was given guest teaching privileges to deliver the virtual education with the assistance of the Health Teachers and IT Liaison. All 8th-grade students received the virtual classroom education on food allergies and anaphylaxis during their assigned health class, which totaled 173 students for week one (module one) and 171 students for week two (module two). The numeric data for student attendance was captured through the Blackboard session reports provided by the IT Liaison. Modules one and two were live but video recorded for 8th-grade students and parents/guardians' future viewing.

Virtual Classroom Modules

Modules were developed based on the identified themes from the literature review, including delay in EAI use relative to the variability of training and education, lack of knowledge and confidence with EAI administration technique, and the impact of device design with carriage and ease of use. Virtual classroom modules focused on the target population of 8th-grade middle school students and their parents/guardians. All information was derived from the Food Allergy Research and Education (FARE®) organization website. Permission was obtained to reproduce education for teaching purposes to students and families (Appendix D: FARE® Permission). FARE® is a free resource available for patients, families, healthcare providers, educators, and other professionals seeking reputable information about food allergies (FARE®, 2021).

Initial virtual teaching modules were developed in July 2020 and revised through final implementation to meet project and organizational needs. Content experts reviewed the modules in compliance with the information derived from the FARE® organization for the virtual classrooms. In module one, a 30-minute recorded PowerPoint presentation was presented live to 8th-grade students during their assigned virtual health class. Topics presented in module one included the definition of a food allergy, common food allergens, food allergy diagnosis, and testing, mild and severe food allergy symptoms, the definition of anaphylaxis and epinephrine, administration of epinephrine, images of EAI devices, adolescent risks, and food allergy statistics. In addition, a public service announcement (PSA), YouTube video, and FARE® hyperlinks were shared with the participants. In module two, a 30-minute recorded PowerPoint presentation was presented live to 8th-grade students during their health class. Topics presented in module two included a FARE® module (12 minutes) from the Food Allergy Learning Academy Save a Life: Recognizing and Responding to Anaphylaxis, the psychosocial impact of food allergies, food allergy bullying prevention, teen resource hyperlinks, and a YouTube video

from FARE® about living with food allergies (Appendix I: Virtual Classroom Modules and Focus Group Curriculum). Both presentations started with disclosure slides.

Pre- and Post-Knowledge and Confidence Questionnaires

All 8th-grade students were provided the questionnaires but were only used in the analysis if the Statement of Participation (see Appendix E) permission forms were complete. The CSN reviewed all permission forms before sharing any data with the DNP student. Questionnaires included:

- Demographic (gender, age, ethnicity & diagnosis of allergy) information
- Ten knowledge questions were adapted from FARE®'s Learning Academy Program Save a Life: Recognizing and Responding to Anaphylaxis
- One self-structured knowledge question (#1 part II) was added as a recall task (qualitative)
- Two self-structured confidence questions were added to elicit the confidence level of participants pre- and post-virtual education
- Questions included multiple-choice, select all that apply, select the best answer, place in step-by-step order, and one free text option (Appendix H: Pre- and Post-Test Questionnaires).

A total of 13 questions were asked, 11 assessing participant knowledge and two assessing confidence levels with food allergies and anaphylaxis. The questionnaires were administered before the first virtual classroom module and immediately following the second virtual classroom module one week later. Questionnaires were provided through Google Forms per the request of the middle school. Upon completing the pre-and post-test, the Google Form went directly to the residency preceptor's (CSN) email. The CSN deidentified all information when

sharing with the DNP student to maintain confidentiality. Participants had approximately ten minutes to complete the questionnaires, which were reading level appropriate for 8th-grade students. Questionnaires were reviewed for quality and appropriateness for the target population by Duquesne University's nursing statistician.

Sixty-three students completed the initial pre-knowledge and confidence questionnaire before education. As for the post-test, students (n=52) completed the post-knowledge and confidence questionnaire. A total of 11 students dropped out. No parents/guardians completed the questionnaires; however, parents/guardians likely participated through viewing the recorded virtual classroom modules.

Focus Group

All participants that completed the Statement of Participation (see Appendix E) permission form (both student and parent forms) were invited to attend a scheduled (3/23/21) focus group via Microsoft Teams during homeroom class. Eleven students but no parents/guardians participated in the focus groups. Focus group discussion notes were hand recorded by the residency preceptor and the DNP student and then compared.

Like classroom education, the focus group was completely virtual; however, this method would be reconsidered for the future. It was challenging to elicit participation and feedback from the students. The focus group agenda included an introduction, a thank you for attending, a review of the group meeting's purpose and goals, ground rules for the discussion, and a timeline for the session. Several issues occurred during the focus group. First, the Microsoft Teams application was not originally downloaded as expected on the student's iPads. Second, it was early in the morning in the library, and overall, students were quiet; only a few 8th-grade students (no parents/guardians) participated in the discussion with some prompting. Third, the overhead

school announcements interrupted the session for several minutes. Fourth, the DNP student could not visualize all students at once on the camera except when they were directly talking with masks covering their faces.

However, on a positive note, all 11 participants (n1) reviewed how to use an EAI device and have hands-on practice with guidance from the CSN. Two different EAI training devices were available for practice. As a result of the focus group, the DNP student will share additional resources, website links, and phone apps about food allergies and anaphylaxis to further engage student learning.

Analysis and Results

A pre-and post-test method was used to evaluate the effectiveness of the virtual classroom. The quantitative data for this project was analyzed using a structured knowledge (ten questions, one self-structured) and a confidence (two self-structured questions) questionnaire for a total of 13 questions. The self-structured knowledge question was transitioned to qualitative data as it yielded more interesting data results.

The knowledge portion of the questionnaire was part of the FARE®'s Learning Academy website and was embedded in the Save a Life: Recognizing and Responding to Anaphylaxis module that all 8th-grade students and parents/guardians had the opportunity to review. The one self-structured knowledge and two confidence questions were reviewed by Duquesne University's statistician for quality and accuracy. A numeric value was assigned to each answer for all of the questions and calculated for total scores. Correct answers were given higher numeric value equaling higher knowledge and confidence (Appendix H: Pre- and Post-Test Questionnaires). The knowledge scoring consisted of select all apply questions (#1, 2, 3, 9) received more points for each correct answer chosen (partial credit given), select the best answer

(#8), and true and false (#4, 5, 6, 7) questions received one point if correct and zero if incorrect, lastly, place steps in order (#10 and #1 in part II) received credit if in the appropriate order. A total point allotment for knowledge was 23/23. Confidence scoring included higher values if higher confidence was chosen (1 to 5) for the two questions. A total point allotment for confidence scores was 10/10.

Detailed demographic information for project participants is shown in Appendix J. The students were predominantly male (58%). The student age range was from 12-14 years, with the majority being 13 years old (58%). The ethnicity varied; most students identified as White (71%). The majority of students (87%) noted they were not diagnosed with food allergies, while 13% indicated they were formally diagnosed.

Participating 8th-grade students (63) completed a pre-test knowledge and confidence questionnaire before the first virtual classroom. Students then participated in the live virtual classroom presentations consisting of module one education during week one of the health class. One week later, all students received module two education, and participating students (n=52) completed the post-test questionnaire.

Quantitative analysis results included both descriptive and inferential statistical analysis. Descriptive statistical analysis, including mean, median, mode, and standard deviation, were used to interpret pre-and post-education intervention data. The mean knowledge scores increased from 63% to 80%, with an overall improvement in student scores of 17% (Appendix K: Knowledge Scores). The median score increased from 65% to 85%, while the mode improved from 65% to 87%. The pre-education knowledge score standard deviation was 0.145 and 0.118 post-education knowledge score. The mean confidence scores increased from 51% to 71%, with an overall improvement in student scores of 20% (Appendix L: Confidence Scores). The median

score increased from 50% to 70%, while the mode improved from 40% to 60%. The pre-education confidence score standard deviation was 0.192 and 0.139 post-education knowledge score. The improvement in scores was expected and achieved.

Inferential statistical analysis, including Paired Sample t-Test (e.g., Students t-Test), was used to compare the participants' pre-and post-knowledge and confidence scores. It was expected that both knowledge and confidence in 8th-grade students would improve after the virtual classroom education using FARE® resources. The means of the pre-and post-knowledge scores showed meaningful improvement ($t = 8.18$, $p < .001$) with a large Cohen's *d* effect size 1.13 (95% CI [0.781,1.48] (Appendix M: Students T-Test; Appendix N: Box Plot Knowledge Scores). The means of the pre-and post-confidence scores also showed meaningful improvement ($t = 8.68$, $p < .001$) with a large Cohen's *d* effect size 1.20 (95% CI [0.843,1.56] (Appendix M: Students T-Test; Appendix O: Box Plot Confidence Scores). The large effect size shows that the educational intervention was effective and meaningful.

Qualitative analysis results included identifying focus group themes and categorizing and coding a knowledge "free text" question. The virtual focus group was offered to 8th-grade students and parents/guardians who signed the Statement of Participation (see Appendix E). The focus group consisted of 11 participants with three prepared discussion questions, including (1) why did you join the focus group today? (2) how did you see the food allergy and anaphylaxis education as being helpful? and (3) what areas do you need more information about food allergies and anaphylaxis? Common themes identified among the participating students were that it provided information to help keep their friends and family members with food allergies safe if and when anaphylaxis occurs. Two students described the food allergy and anaphylaxis virtual classroom education as "good to know if you have a run-in with a friend or stranger," and it

provides “better insight how to deal with people who have allergies and keep them safe.” The themes indicated that the participating students found the virtual classroom both valuable and beneficial.

The “free text” question emphasized that students lacked knowledge with proper EAI device administration techniques in the pre-test questionnaire; however, in the post-test, there were noteworthy improvements (Appendix P: Pre-Test Qualitative Free Text; Appendix Q: Post-Test Qualitative Free Text). Student participants were asked to describe how to administer an EAI device; 42% of students in the pre-test stated, “I do not know what to do, and in the post-test, only 6% of student participants stated, “I do not know what to do.” Notably, 33% of students in the pre-test described that an EAI device should be administered into the thigh. After education interventions, the post-test revealed that 75% of students identified the thigh as the proper administration site of the EAI device. Interestingly, 7% of students identified in the pre-test that administering epinephrine in the neck, vein, or arm was an option, which can have serious side effects; in the post-test, only 2% of participants noted the neck, vein, or arm as a viable option for EAI administration. Intramuscular (IM) administration in the vastus lateralis muscle enhances absorption of epinephrine because of the increased blood supply, and it is the recommended site for an epinephrine auto-injector device (FARE®, 2021). When injected properly, it instantly relaxes the muscles in the airway; intravenous (IV) injection is contraindicated for self-injection.

Outcome Measures

The aims of this DNP project were achieved through assessment, implementation, evaluation, and sustainment of virtual classroom modules focused on food allergy and anaphylaxis education in one middle school.

The first outcome of the assessment was achieved by identifying the lack of food allergy education in the health curriculum in middle school. Next, the DNP student and site preceptor reviewed anaphylactic events and prevalence data of food allergies in middle school and the entire school district from 2019-2021 (Appendix F: School District Allergy Statistics). In 2020-2021, 24% of students (136) in the middle school and 17% (1,463) in the school district identified as having food allergies (bee stings included). In 2019-2020, three anaphylactic events occurred in the school district during school hours. This information further supported and provided a rationale for developing a virtual classroom program targeting improved knowledge and confidence with food allergies and anaphylaxis in 8th-grade students and parents/guardians.

The second implementation outcome was accomplished by coordinating with the CSN and Health/Physical Education teachers to implement a virtual classroom for all 8th-grade students during their assigned health class using FARE® resources. This collaboration supports the CDC recommendations to educate students and families about food allergies. Parents/guardians were invited to participate in the project and were provided links accessing the live virtual classroom. A recorded version was also available. The virtual classroom was provided over two weeks with two separate education modules to all 8th-grade students totaling 173 participants for module one and 171 in module two. Student attendance was evaluated through Blackboard Collaborate reports.

The third outcome of the evaluation was achieved by measuring the effectiveness of the virtual classroom using a pre-and post-knowledge and confidence questionnaire. Participants (n=52) that signed the Statement of Participation permission form were included in the data analysis. The knowledge scores showed a 17% improvement, and the confidence scores showed a 20% improvement from pre- to post-education intervention.

The fourth outcome of sustaining a plan will be to share data with key stakeholders within the school district, highlighting student improvement in knowledge and confidence resulting from implementing the food allergy virtual classroom. Information will also be provided to the key stakeholders reviewing qualitative data obtained through the focus group identifying the central theme of lacking knowledge and recognition of the importance of helping peers during emergencies (i.e., anaphylaxis) aligning with the school district's mission, vision, and values. A brief report will also be provided to the FARE® organization detailing the DNP project outcomes and meaningful improvement from the pre-and post-education questionnaires.

Several anticipated project outcomes that were not measured relative to the project timeline but are anticipated due to the education include reducing emergency room visits, allergist visits, and hospital admissions. In addition, the use of EAIs as first-line treatment during anaphylaxis will likely occur.

Discussion

Ethical Considerations

The implementation of this DNP project included adolescents as participants, which was an important ethical consideration. Preliminary approval was granted for project implementation in the school district by school administrators. The project was approved by the Duquesne Institutional Review Board (IRB) on November 8, 2020 (Appendix G: IRB Approval). The IRB approval was shared with key stakeholders within the school district. The DNP project required a signed Statement of Participation (see Appendix E) permission from the 8th-grade students and parents/guardians to voluntarily participate in the pre-and post-knowledge and confidence questionnaires and the focus group. The residency preceptor was responsible for all email correspondence with 8th-grade students and parents/guardians throughout the project.

Information was shared with the DNP student once permission was obtained and deidentified. No conflicts of interest were noted. The DNP student works as a substitute school nurse within the district but refrained from working at the project site during the project timeframe.

Interpretation

The virtual classroom project yielded meaningful results and significant improvement in both knowledge and confidence scores in food allergy and anaphylaxis awareness for participating 8th-grade students. Brockow et al. (2015) supported that structured patient education programs (e.g., virtual classroom project) may be beneficial in the management of anaphylaxis by increasing patients' (and students') empowerment to prevent and treat the disease. This DNP project aligned with the guidelines set forth by the Centers for Disease Control and Prevention recommending education for all students and families about food allergies in school. This DNP project positively impacted 8th-grade students and parents/guardians as it (1) achieved improvement in measured outcomes, (2) accomplished successful interprofessional collaboration with the residency preceptor (CSN), Physical Education/Health Teachers, and the Information Technology Department, and (3) accrued minimal cost to the school district (e.g., time).

Limitations

There were four limitations noted in this DNP project, including the Covid-19 pandemic, virtual learning, absent parent/guardian completed questionnaires, and limited generalizability of the data. Initially, the DNP project was planned to be in-person when first developed; however, the school district decided to transition the project completely virtual with the ever-changing school year reverting back and forth from remote learning. Although virtual learning was successful, it limited interactions and contact with students that might learn better in person. The CSN and Health Teachers invited parents/guardians to participate via email throughout the

project. However, no documented adults completed any of the questionnaires but likely viewed the education modules as they had full access to the recorded learning through Blackboard. Lastly, the generalizability of the data is limited to one middle school.

Recommendations

Recommendations for the sustainability of improvement in knowledge and confidence with food allergies and anaphylaxis within the school district include (1) incorporating all grade levels, and schools (elementary through senior high school) in age-specific food allergy curriculum, (2) encourage more family participation in learning about food allergies as recommended by the CDC, the FARE® organization and the National School Nurses Association, and (3) provide both virtual and in-person learning opportunities to further engage student and parent/guardian participation.

Conclusions

Six million children in the United States are diagnosed with food allergies. It is the charge of both healthcare professionals and educators to collaborate and address this growing epidemic. Implementing this virtual classroom within the school district was extraordinarily valuable; closing the knowledge and confidence gap may very well save a student's life. The nursing implications of this DNP project include supporting evidence-based practice while encouraging both student and parent/guardian participation. Increased awareness and reinforcement of food allergy and anaphylaxis education in the health curriculum and beyond is vital for the health and safety of students in school.

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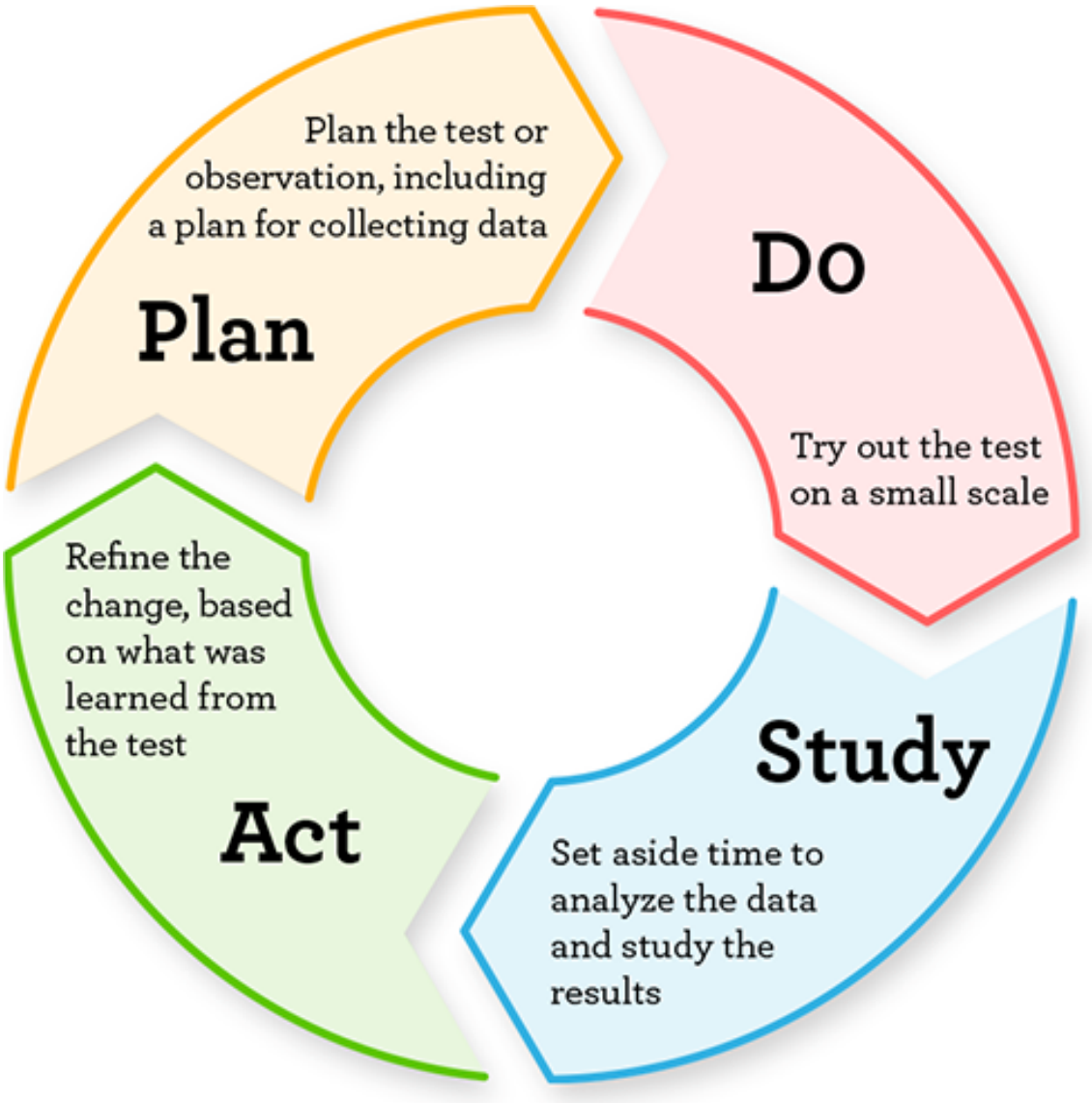
Appendix A

PDSA Cycle



Note: Institute of Healthcare Improvement (IHI) Model, Plan-Do-Study-Act, https://www.huskyhealthct.org/providers/PCMH/pcmh-quality-improvement.html

Appendix B

Framework for 21st Century School Nursing Practice™

Note. Framework for 21st Century School Nursing Practice™, https://www.nasn.org/nasn/nasn-resources/professional-topics/framework

Appendix C

National Association of School Nurses (NASN) Permission

NASN
National Association of School Nurses

1100 Wayne Avenue, Suite 925
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301-585-1791 (fax)
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NAME: Jodi Licata	TITLE: Mrs
ORGANIZATION: Duquesne University	NONPROFIT: ◯ YES ◉ NO
ADDRESS: 9226 Willoughby Road	PHONE: 412-953-4962
CITY: Pittsburgh	E-MAIL: jodilicata@gmail.com
STATE: Pennsylvania	FAX:
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Signature: Jodi Licata Date: 9/3/2020

Internal Use: ***APPROVED*** *By Jon Lemich at 11:19 am, Sep 04, 2020*

Approved by: Date:

Note. NASN Permission to Reprint/Use

Appendix D

FARE® Permission

May 8, 2020

Jodi Licata
9226 Willoughby Road Pittsburgh, PA 15237

Dear Ms. Licata:

I am pleased to provide written permission to Jodi Licata to share materials copyrighted by FARE with middle-school students in the North Allegheny School District as part of her research to complete a Doctor of Nursing Practice (DNP) degree from Duquesne University in Pittsburgh, Pennsylvania.

At the conclusion of her project, Ms. Licata will provide a written report to FARE detailing the impact and reach of the FARE materials used in her research.

Any reproductions of copyrighted FARE materials shared with the middle-school students and/or reproduced in Ms. Licata's dissertation must credit FARE as follows:

© FARE (Food Allergy Research & Education). Used with permission.

Please let me know if you need anything else.
Sincerely,

Kathleen Vickers
Manager, Writer/Editor
Food Allergy Research & Education (FARE) kvickers@foodallergy.org

Appendix E

Statement of Participation Form for 8th-Grade Students and Parents/Guardians

Disclaimer: This self-structured Statement of Participation in a Quality Improvement project is conducted by Mrs. Jodi Licata, Doctor of Nursing Practice (DNP) student, Duquesne University, Pittsburgh, Pa. Mrs. Jodi Licata has no Conflict of Interest or financial interest associated with this project. This Statement of Participation will solely be used for the educational activities related to a Quality Improvement project. The details of the project will be provided to the participants. All participation is voluntary.

Statement of Participation in a Quality Improvement Project for 8th-grade students
Participant's Name:
Today's Date:
Project Champion: Mrs. Jodi Licata, Doctor of Nursing Practice Student, Duquesne University
Project Title: *Engaging Middle School Students and Parents/Guardians via structured virtual media on Food Allergy and Anaphylaxis Awareness: A Quality Improvement Project*

Why am I receiving this information?

I would like you to have an opportunity to participate in an educational activity in a Doctor of Nursing practice (DNP) quality improvement (QI) project.

Why is this QI project being done?

This project is being done to enhance 8th grade students and parents/guardian's knowledge and confidence in regards to food allergies and anaphylaxis awareness.

How many other children will take part in this QI project?

Participation will be offered to all 8th grade students and parents/guardians at Marshall Middle School in the North Allegheny school district. It is a volunteer participation. You are free to leave the educational activity at any time.

How long will I be in this QI project?

The project will last for approximately 4 weeks. You can stop being in the project at any time for any reason. The learning modules will be virtual and will be completed through your Health class curriculum. Each module will take approximately 10-15 minutes to review in Blackboard.

There will be one quiz within the modules to check for knowledge and receive certification of anaphylaxis awareness. Timeline may vary.

What do I have to do, if I participate in the QI project?

- Agree to participate by signing the Statement of Participation form (December 2020 - January 2021)
- Parents/guardians will sign the Statement of Participation form for students to participate (December 2020 - January 2021)
- Complete a pre-test knowledge questionnaire (January 2021)
- View all assigned food allergy and anaphylaxis modules via Blackboard for your Health class. There will be approximately six educational modules over four weeks. (February 2021)
- Complete a post-test knowledge questionnaire (March 2021)
- You may be asked to participate in a virtual focus group if you have a food allergy (6-12 students will be selected). The focus groups are voluntary not mandatory.

What are the risks of taking part in this QI project?

There are no identified risks if you choose to partake in this project.

What are the benefits of taking part in this QI project?

If you partake in this project the potential benefits are increased knowledge and awareness with food allergies and anaphylaxis.

Will I get paid to be in this QI project?

No, there is no payment associated with this project. In order to be respectful to your volunteer participation, the participants will be placed into a raffle for a $25.00 gift card if the modules are completed and submitted to the NASD health/PE teacher.

***All information regarding students (names) will be deidentified.**

Who do I call if I have questions or problems?

Any questions should be directed to the certified school nurse at Marshall Middle School Bridgett Bilenski bbilenski@northallegheny.org or (724) 934-6060 option #2

Bridgett Bilenski will notify Jodi Licata (project champion) as needed with any questions or concerns pertaining to this quality improvement project.

Once you have made your decision, please check one of the boxes below and sign your name.

❒ Yes, I will take part in this quality improvement project. This may include a virtual focus group (if selected) if you have a food allergy. Please email this form Bridgett Bilenski to confirm participation bbilenski@northallegheny.org

❒ No, I do not want to take part in this quality improvement project

Signature of Child

Printed Name of Child Date

Disclaimer: This self-structured Statement of Participation in a Quality Improvement project is conducted by Mrs. Jodi Licata, Doctor of Nursing Practice (DNP) student, Duquesne University, Pittsburgh, Pa. Mrs. Jodi Licata has no Conflict of Interest or financial interest associated with this project. This Statement of Participation will solely be used for the educational activities related to a Quality Improvement project. The details of the project will be provided to the participants. All participation is voluntary.

	Statement of Participation in a Quality Improvement Project for parents/guardians
Parent/guardian Name :	
Today's Date:	
Project Champion: Mrs. Jodi Licata, Doctor of Nursing Practice Student, Duquesne University	
Project Title: *Engaging Middle School Students and Parents/Guardians via structured virtual media on Food Allergy and Anaphylaxis Awareness: A Quality Improvement Project*	

The educational intervention (5 modules) will be provided virtually through Blackboard assigned by the Health/PE teachers. Students will submit for completion.

Students will be completing a pre-knowledge questionnaire and post-knowledge questionnaire about food allergies and anaphylaxis awareness. Curriculum timeline may change based on Health/PE teacher recommendation related to COVID-19.

*Parents/guardians will also be encouraged to complete a pre-knowledge and post knowledge questionnaire

Proposed education modules will include information directly from the *Food Allergy Education & Research (FARE®)* website.

These educational modules will be available for all parents to review with along with their child. Timeline may vary.

- *Food Allergies 101 (week 1)*
- *Treating Severe Allergic Reactions (week 2)*

- *Save a Life: Recognizing & Responding to Anaphylaxis, certification of knowledge embedded in module to complete (week 3)*
- *Food Allergies: Final Thoughts (week 4)*
- *Food Allergies: Bullying Prevention (week 5)*
- *Food Allergy case study (optional)*

Participation is completely voluntary; students may stop at any time and there is no financial obligation associated with this project. Parents/guardians of students with food allergies may be asked to participate in a virtual focus group at the end of the project which is voluntary not mandatory.
Any questions should be directed to the certified school nurse at Marshall Middle School Bridgett Bilenski bbilenski@northallegheny.org or (724) 934-6060 option #2

Bridgett Bilenski will notify Jodi Licata (project champion) as needed with any questions or concerns pertaining to this quality improvement project

Once you have made your decision, please check one of the boxes below and sign your name.

❒ Yes, I am agreeing for my child (8th grade student) to participate in this quality improvement project. This may include a virtual focus group if your child (if selected) has a food allergy. Please email this form Bridgett Bilenski to confirm participation bbilenski@northallegheny.org

❒ I am also planning to participate in the education modules and questionnaires as indicated. This may include a virtual focus group (if selected) if you are a parent/guardian of a student with a food allergy.

❒ No, I do not want my child to take part in this quality improvement project

Printed Name of Parent/Guardian

Signature of Parent/Guardian Date

Appendix F

School District Allergy Statistics for 2019-2021

Allergies	**2019-2020**		**2020-2021**	
	District	**(project site)**	**District**	**(project site)**
Bee Stings	57	(7)	65	(4)
Peanut	279	(33)	315	(28)
Tree Nut	353	(47)	399	(37)
Other food allergies	593	(56)	684	(67)
TOTAL	**1282**	**(136)**	**1463**	**(136)**
# of 911 calls due to Anaphylaxis episodes	**3**		0	(0)
# of allergy medications administered to students	10 (3 EpiPen's, 7 antihistamines)		23 (all antihistamines)	(2)

Appendix G

Duquesne University Institute Review Board (IRB) Approval

Attachments:
• Quality Improvement Verified - IRB ID: 2020/11/4.pdf

Institutional Review Board
DUQUESNE UNIVERSITY

Duquesne University IRB *QI Protocol Notification*

To: Jodi Licata
From: David Delmonico, IRB Chair
Subject: Protocol #2020/11/4
Date: 11/08/2020

The protocol **2020/11/4. Engaging Middle School Students and Parents/Guardians via structured virtual media on Food Allergy and Anaphylaxis Awareness: A Quality Improvement Project** has been verified by the Institutional Review Board as a **Quality Improvement Project**, and accordingly does not meet the definition of "research" at to 45CFR46.102(d). Your protocol is thus exempt from IRB review.

Please note that changes to your protocol may affect its exempt status. Please contact me directly to discuss any changes you may contemplate.

Thanks,

David Delmonico, Ph.D.
Institutional Review Board, Chair
irb@duq.edu

Appendix H

Pre- and Post-Knowledge and Confidence Questionnaires

PRE-Virtual Classroom Questionnaire Part I

Demographic questions on Google Forms

PART I Knowledge Check (answers highlighted in yellow, point allotment in green total 23)

1) Anaphylaxis is: ***Select all that apply. 4 points***
   a.) Severe and life-threatening food allergy
   b.) An allergic reaction to a normally harmful substance
   c.) A situation where every second counts
   d.) Treated with epinephrine

2) Jimmy is eating at a restaurant and tells the server that he has a severe nut allergy. Which symptom by itself would indicate that Jimmy needs epinephrine? ***Select all that apply. 3 points***
   a.) Trouble breathing
   b.) Pale or bluish skin
   c.) Sneezing
   d.) Many hives or widespread redness

3) Karen is allergic to bee stings. She wears long pants and shirts to protect herself but when she gardening, she is accidentally stung on the hand. Read the answer choices below. What symptom by itself would suggest Karen needs epinephrine? ***Select all that apply. 2 points***
   a.) A few hives
   b.) Many hives
   c.) Itchy skin
   d.) Dizzy feeling

4) One dose of epinephrine will always stop anaphylaxis. ***Select true or false. 1 point***
   a.) True
   b.) False

5) If someone is experiencing anaphylaxis and they carry an epinephrine auto-injector, you should call 911 and then try to help them by administering the medicine. ***Select true or false. 1 point***
   a.) True
   b.) False

6) Anyone who experiences anaphylaxis must go to the hospital because they may experience a return of symptoms. ***Select true or false. 1 point***
   a.) True
   b.) False

7) For someone with a food allergy, ingesting even tiny amounts of allergen can cause anaphylaxis. ***Select true or false. 1 point***
   a.) True
   b.) False

8) Typically reactions occur within minutes of ingestion and most occur within two hours. However, someone with allergies could experience anaphylaxis up to ___ hours after they ingest an allergen. ***Select the best answer. 1 point***
   a.) Half an hour
   b.) One hour
   c.) Two hours
   d.) Four hours

9) You can recognize anaphylaxis by looking for any of these severe symptoms. Select all that apply. ***Select all that apply. 6 points***
   a.) Shortness of breath, wheezing or a repetitive cough
   b.) A tight hoarse throat, trouble breathing or swallowing
   c.) Significant swelling of the tongue or lips
   d.) Many hives all over the body or widespread redness
   e.) Repetitive vomiting or severe diarrhea
   f.) A feeling that something bad is about to happen, anxiety or confusion

10) What should you do if you recognize anaphylaxis and have epinephrine available? ***Please put the steps in order. 3 points***
   Call 911
   Give epinephrine
   Monitor the person

   1.) Give epinephrine
   2.) Call 911
   3.) Monitor the person

PART II Knowledge Check (self-structured)

1.) If you plan to administer an epinephrine auto-injector to yourself or someone else please describe how. For this scenario an EpiPen® will be used. ***Please put the steps in order.*** ***Qualitative question***

1.)
2.)
3.)
4.)

1.) Remove the EpiPen®auto-injector from the clear carrier tube
2.) Grasp the auto-injector in your fist with the orange tip (needle end) pointing downward. With your other hand, remove the blue safety release by pulling straight up
3.) Swing and push the auto-injector firmly into the middle of the outer thigh until it 'clicks'. Hold firmly in place or 3 seconds (count slowly)
4.) Remove and massage the injection area for 10 seconds. Call 911 and get emergency help right away

Confidence Check (self-structured) *point allotment in green total 10*

1.) Are you confident that you can identify an anaphylactic reaction? ***5 points***

a.) Very high confidence
b.) High confidence
c.) Medium confidence
d.) Low confidence
e.) Very low confidence

2.) Are you confident that you can safely administer an epinephrine auto-injector if necessary, during an anaphylactic event? ***5 points***

a.) Very high confidence
b.) High confidence
c.) Medium confidence
d.) Low confidence
e.) Very low confidence

POST-Virtual Classroom Questionnaire Part I (answers highlighted above, point allotment same as above)

Demographic questions on Google Forms

PART I Knowledge Check

1) Anaphylaxis is: ***Select all that apply.***
   a.) Severe and life-threatening food allergy
   b.) An allergic reaction to a normally harmful substance
   c.) A situation where every second counts
   d.) Treated with epinephrine

2.) Jimmy is eating at a restaurant and tells the server that he has a severe nut allergy. Which symptom by itself would indicate that Jimmy needs epinephrine? ***Select all that apply.***
   a.) Trouble breathing
   b.) Pale or bluish skin
   c.) Sneezing
   d.) Many hives or widespread redness

3.) Karen is allergic to bee stings. She wears long pants and shirts to protect herself but when she gardening, she is accidentally stung on the hand. Read the answer choices below. What symptom by itself would suggest Karen needs epinephrine? ***Select all that apply.***
   a.) A few hives
   b.) Many hives
   c.) Itchy skin
   d.) Dizzy feeling

4.) One dose of epinephrine will always stop anaphylaxis. ***Select true or false.***
   a.) True
   b.) False

5.) If someone is experiencing anaphylaxis and they carry an epinephrine auto-injector, you should call 911 and then try to help them by administering the medicine. ***Select true or false.***
   a.) True
   b.) False

6.) Anyone who experiences anaphylaxis must go to the hospital because they may experience a return of symptoms. ***Select true or false.***
   a.) True
   b.) False

7.) For someone with a food allergy, ingesting even tiny amounts of allergen can cause anaphylaxis. ***Select true or false.***
   a.) True
   b.) False

8.) Typically reactions occur within minutes of ingestion and most occur within two hours. However, someone with allergies could experience anaphylaxis up to ___ hours after they ingest an allergen. ***Select all the best answer.***
   a.) Half an hour
   b.) One hour
   c.) Two hours
   d.) Four hours

9.) You can recognize anaphylaxis by looking for any of these severe symptoms. Select all that apply. ***Select all that apply.***

   a.) Shortness of breath, wheezing or a repetitive cough
   b.) A tight hoarse throat, trouble breathing or swallowing
   c.) Significant swelling of the tongue or lips
   d.) Many hives all over the body or widespread redness
   e.) Repetitive vomiting or severe diarrhea
   f.) A feeling that something bad is about to happen, anxiety or confusion

10.) What should you do if you recognize anaphylaxis and have epinephrine available? ***Please put the steps in order.***
   Call 911
   Give epinephrine
   Monitor the person

   1.)
   2.)
   3.)

PART II Knowledge Check (self-structured)

1.) If you plan to administer an epinephrine auto-injector to yourself or someone else please describe how. For this scenario, an EpiPen® will be used. ***Please put the steps in order.***

    1.)
    2.)
    3.)
    4.)

Confidence Check (self-structured)

1.) Are you confident that you can identify an anaphylactic reaction?

    a.) Very high confidence
    b.) High confidence
    c.) Medium confidence
    d.) Low confidence
    e.) Very low confidence

2.) Are you confident that you can safely administer an epinephrine auto-injector if necessary, during an anaphylactic event?

    a.) Very high confidence
    b.) High confidence
    c.) Medium confidence
    d.) Low confidence
    e.) Very low confidence

Appendix I

Virtual Classroom Learning Modules and Focus Group Curriculum and Timeline

Weeks	Didactic Instruction
Week 1 (1/4/2021) -Video Introduction sent via email to students about virtual classroom project with permission forms attached -Informative email sent to parents/guardians about the project with permission forms attached -Voluntary Participation Form obtained from 8th-grade students & parents/guardians **Week 1 (1/6/2021)** • Pre- knowledge & confidence questionnaire administered before education started • Module 1	**Module 1: Food allergies 101** • FARE® Public Service Announcement • What is a food allergy? • Nine most common food allergens • Diagnosis & testing of food allergies • Mild & severe symptoms of food allergies • What is anaphylaxis? • What is epinephrine, and how to administer it? • Review of EAI • Key points to remember if experiencing anaphylaxis • Why focus on the adolescent population? • Food allergy statistics • Review of FARE® website
Week 2 (1/13/2021) • Module 2 • Post-knowledge & confidence questionnaire administered after education complete	**Module 2: Saving a Life** • Recognizing & Responding to anaphylaxis FARE® course • Teen resources post allergic reaction • Psychosocial impact of food allergies • Bullying prevention • FARE® final thoughts video on food allergies
Focus Group (3/23/2021) Email with Focus Group Flyer shared with 8th-grade students and parents/guardians Post-Focus Group shared additional education with the CSN for the participants $25 Amazon gift card raffled provided to one participant of Focus Group	**Discussion questions** • Icebreaker: Do you know at least one person with a food allergy (may include self)? • Why did you join the focus group? • How did you see this education as being helpful? • What areas do you need more information in about food allergies or anaphylaxis?

	*CSN demonstrated proper EAI administration technique and allowed each student to practice with either the EpiPen® or Auvi Q® training devices. No actual needles were used during the practice sessions *Emailed additional references and phone apps to CSN to share with students as a result of the Focus Group discussions

Virtual Classroom Module 1 link:
https://onedrive.live.com/edit.aspx?resid=AF73D8AD67C8B46F!497&ithint=file%2cpptx&authkey=!AssKzVmf1LI66RM
Virtual Classroom Module 2 link:
https://onedrive.live.com/edit.aspx?resid=AF73D8AD67C8B46F!498&ithint=file%2cpptx&authkey=!Ap45SQx1xf9QM48

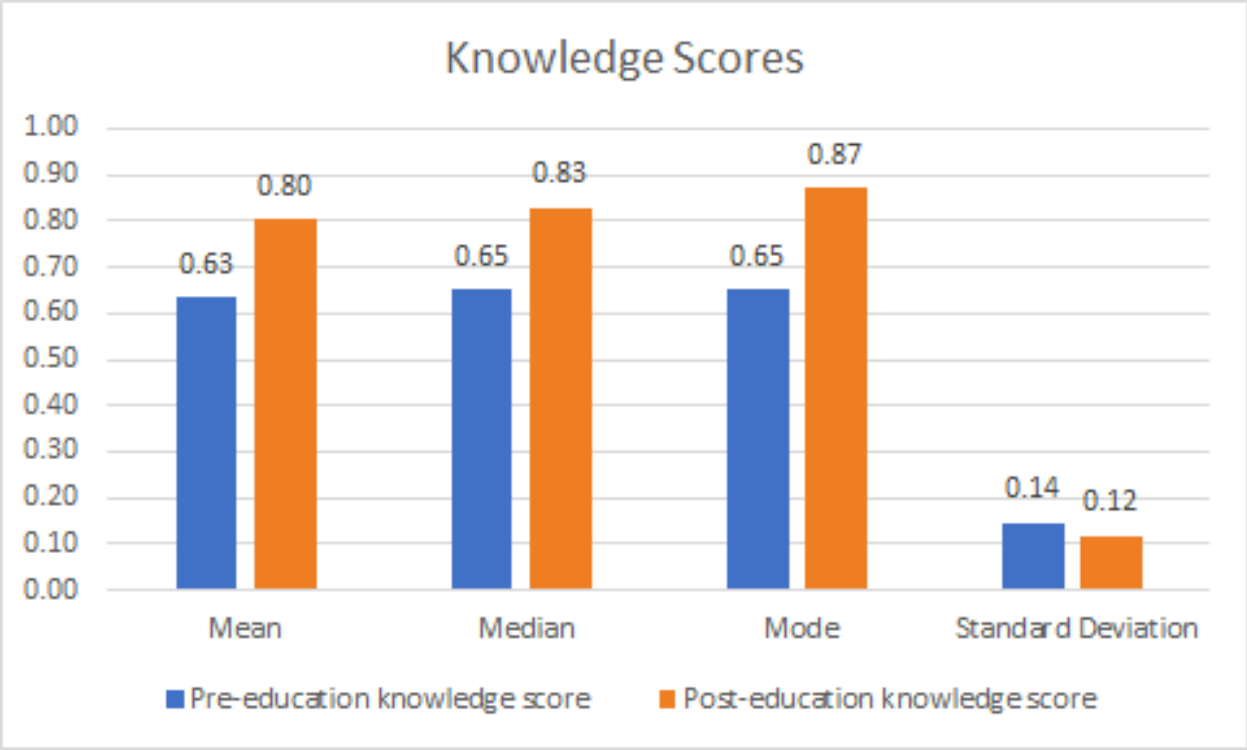
Appendix J

Participant Demographics

Total Sample n=52	Total number (percentages)
Age	12 years 1 (2%) **13 years 30 (58%)** 14 years 21 (40%) >18 years 0 (0%)
Gender	Prefer not answer 1 (2%) Female 21 (40%) **Male 30 (58%)**
Ethnicity	Black 0 (0%) Native Hawaiian 1 (2%) or Pacific Islander Other 2 (4%) Prefer not to answer 2 (4%) Asian 10 (19%) **White 37 (71%)**
Diagnosed food allergies	Yes 7 (13%) **No 45 (87%)**

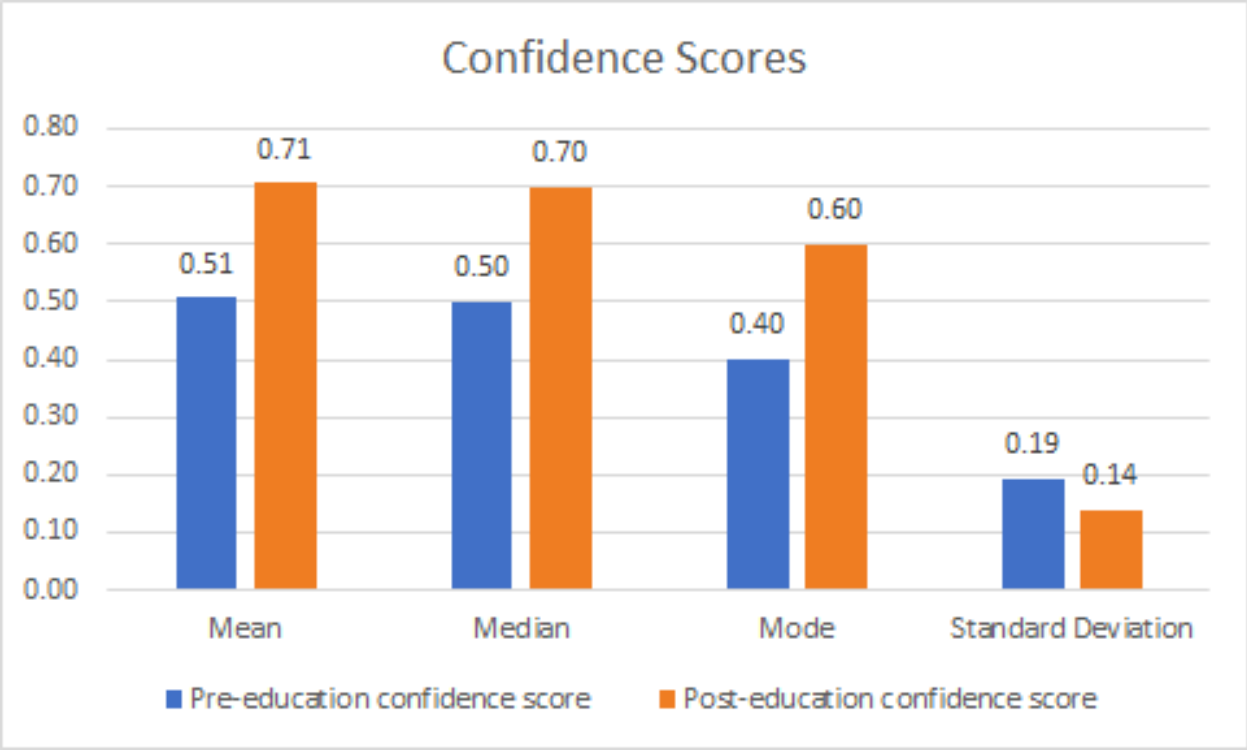
Appendix K

Pre-and Post-Education Knowledge Scores



Appendix L

Pre-and Post-Education Confidence Scores



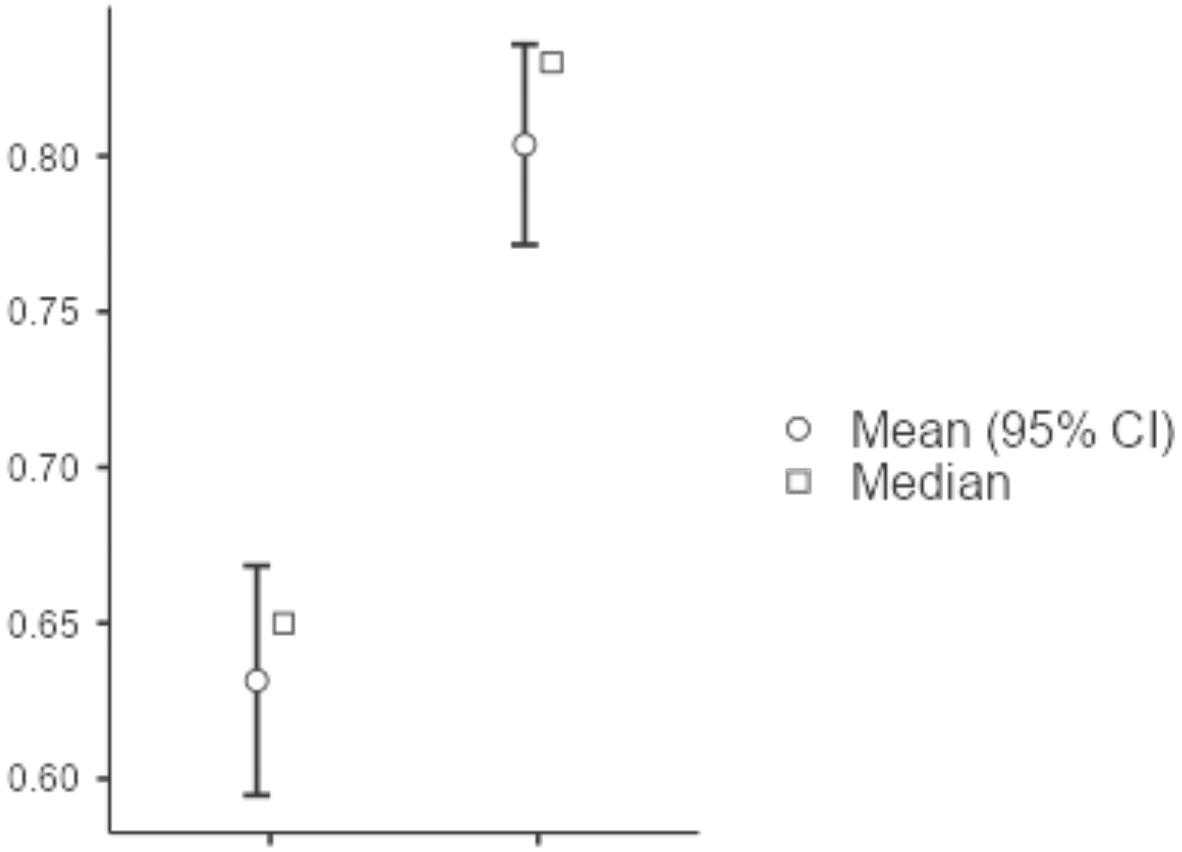
Appendix M

Paired Sample T-Test Comparing Pre-Education with Post-Education Scores

Paired Sample T-Test: Student's t N=52	T-value statistic	df	p	Mean difference		Effect Size	95% CI
Pre-education **knowledge** score Post-education **knowledge** score	8.18	51.0	<.001	0.172	Cohen's d	1.13	Upper 1.48 Lower 0.781
Pre-education **confidence** score Post-education **confidence** score	8.68	51.0	<.001	0.210	Cohen's d	1.20	Upper 1.56 Lower 0.843

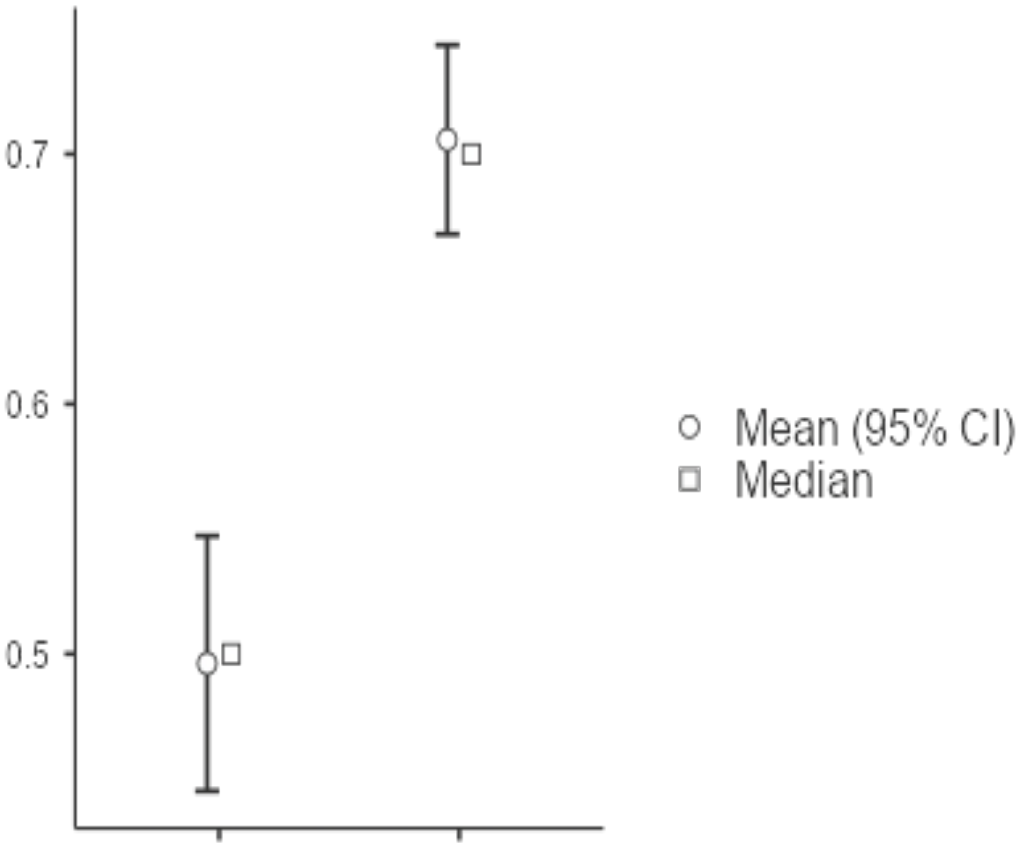
Appendix N

Pre-and Post-Education Knowledge Scores with Effect Size Distribution



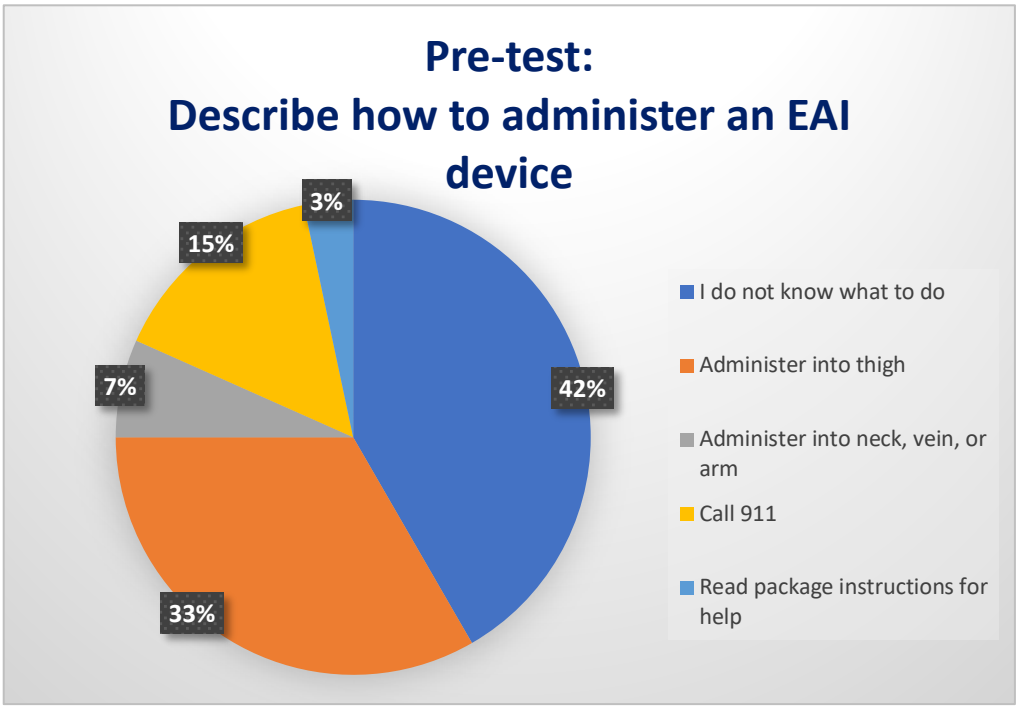
Appendix O

Pre-and Post-Education Confidence Scores with Effect Size Distribution



Appendix P

Pre-Test Qualitative Free Text Question



Appendix Q

Post-Test Qualitative Free Text Question