HYBRIDIZING THE HEALTH EDUCATION COMPONENT OF HEALTHCARE

A disquisition presented to the faculty of the Graduate School of
Western Carolina University in partial fulfillment of the
Requirements for the degree of Doctor of Education

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I am grateful to the incredibly hardworking and dedicated farmworkers in western North Carolina and beyond who help sustain our existence by bringing food to our tables. This disquisition was originally inspired by efforts to improve farmworker access to healthcare and health education in partnership with Vecinos Farmworker Health Program (Vecinos) who work tirelessly in complex systems to help meet the health and healthcare needs of farmworkers in western North Carolina. The Vecinos team consistently noted that farmworkers reported experiencing musculoskeletal health issues and sought to collaborate with the physical therapy department at Western Carolina University (WCU) to help address these issues. I am inspired by the heart-led work of their team. I am grateful that my academic physical therapy colleague and mentor Karen Lunnen invited me to partner with her in this work which she was already leading when I arrived at WCU in 2012.

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DEDICATION

This work is dedicated to my family. I am forever indebted to my wife Danielle for her ongoing support of my educational endeavors and commitment to this work. The work is also inspired by my children August and Camden whose energy, curiosity, and unstoppable spirit of growth perpetually challenge me to be a better person and to help create a more just and equitable world.

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Meaning
CHW	Community Health Worker
EdD	Doctor of Education
FtF	Face-to-Face
HCP	Health Care Provider
ICT	Information and Communication Technology
LMS	Learning Management System
MSK	Musculoskeletal
MSAW	Migrant Seasonal Agricultural Worker (also referred to as Farmworker)
NCFHP	North Carolina Farmworker Health Program
PDSA	Plan-Do-Study-Act
Vecinos	Vecinos Farmworker Health Program

TABLE OF CONENTS

ABSTRACT

HYBRIDIZING THE HEALTH EDUCATION COMPONENT OF HEALTHCARE

John Andrew Carzoli, Ed.D.

Western Carolina University (October 2021)

Disquisition Chair: Dr. Jess Weiler

This disquisition employed a "dissertation in practice" (Carnegie Project on the Education Doctorate, 2021) model, wherein scholar-practitioners (SP) in EdD programs lead an organizational improvement initiative that seeks to address an equity-oriented problem of practice. For this disquisition, two interrelated problems were addressed. Problem one (framed as an institutional problem) is related to the suboptimal value offered by the healthcare system in the United States (U.S.). Problem two, (framed as a human problem), explores the lack of access provided to migrant and seasonal agricultural workers (MSAW) to preventative musculoskeletal (MSK) health education. This disquisition suggests that the value of healthcare, defined simply by Porter and Teisberg (2006) as health outcomes per dollar spent, and access to valuable health education could be improved in the U.S. and beyond by systemizing the delivery of health education in a hybridized manner that combines traditional face-to-face (FtF) delivery with digital and electronic mediums. The improvement initiative included the use of a learning management system (LMS) to disseminate the health education/courses intended for MSAW and other stakeholders involved in agricultural health. To explore the effectiveness of the LMS toward increased healthcare access and value, formative and summative data were collected through post course surveys, pretest/posttest assessment of learning, course utilization analytics

built into the LMS, and semi-structured interviews with key stakeholders in agricultural health. Implications of the initiative in the global context include the potential to improve the value of healthcare through more effective health education and better health outcomes at lower costs. Implications in the context of MSAW MSK health include the potential to improve (a) knowledge and confidence related to prevention and self-care of musculoskeletal health conditions common in agriculture, (b) access to, awareness of, and utilization of evidence-informed health education that emphasizes prevention and self-care related to musculoskeletal health issues associated with agricultural work, and (c) the value of health education estimated by learning outcomes and learner perceptions.

Keywords: health education, hybrid learning, healthcare

THE DISQUISITION

This disquisition follows the "dissertation in practice" framework developed by members of The Carnegie Project on the Education Doctorate (CPED) for Doctor of Education (EdD) programs. CPED defines the dissertation in practice as "a scholarly endeavor that impacts a complex problem of practice" and defines a problem of practice as "a persistent, contextualized, and specific issue embedded in the work of a professional practitioner, the addressing of which has the potential to result in improved understanding, experience, and outcomes" (Carnegie Project on the Education Doctorate, 2021). The leaders of the Executive EdD program in Educational Leadership at Western Carolina University (WCU) use the term disquisition in lieu of dissertation in practice. The mission of the EdD program at WCU of developing "educational leaders oriented toward continuous improvement, scholarly practice, collaboration, student-centered decision making, and equity and social justice" is firmly embedded in the disquisition (Western Carolina University EdD Degree, 2021). The disquisition differs from the conventional dissertation by integrating traditional scholarship methodologies with improvement science to test and evaluate change strategies in practical contexts, and in doing so seeks to "extend the boundaries of traditional thinking" (Lomotey, 2018). Because the disquisition explores a problem of practice in the candidate's chosen field, the disquisitioner is uniquely considered a scholar practitioner in serving both the role of the scholar/researcher and of the practitioner working to facilitate and lead positive change efforts in the direct area of their field.

Hybridizing the Health Education Component of Healthcare

Exploring the Problems

This disquisition describes and explores two related problems in the realm of healthcare and health education. Problem one, referred to as an institutional problem, is related to suboptimal value offered by the healthcare system in the United States (U.S.). The improvement initiative described in this disquisition suggests that the value of healthcare, defined simply by Porter and Teisberg (2006) as health outcomes per dollar spent, could be improved in the U.S. and beyond. This disquisition focuses on systemizing the delivery of health education in a hybridized manner that couples traditional face-to-face (FtF) educational delivery with asynchronous digital and electronic mediums.

Problem two, referred to as a human problem, seeks to test such a model of hybridized health education in two groups associated with agricultural health, including migrant and seasonal agricultural workers (MSAW) who have limited access to preventive musculoskeletal (MSK) health education, and those who serve the health needs of these MSAW including community health workers (CHW). If effective, the improvement initiative utilized to address problem two has important implications for improving the value of healthcare noted in problem one. Although the background below expounds on both problems, the improvement initiative is aimed primarily at problem two.

Background

Problem One: An Institutional Problem of Suboptimal Healthcare Value

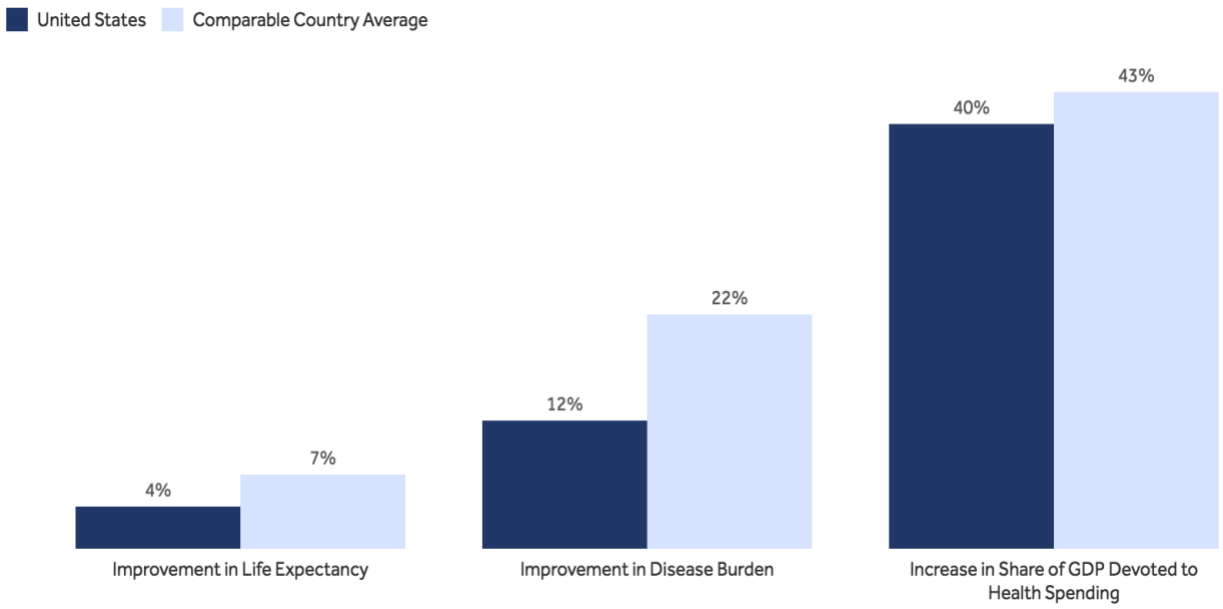
Healthcare spending in the United States totaled $3.65 trillion in 2018, which was a 4.4% increase from 2017 and nearly three times the current annual inflation rate of 1.6%. This spending is by far the highest in the developed world (Organisation for Economic Co-operation

and Development, 2018) with growth predicted to continue at an annual rate of 5.5% from 2018-2027 according to a report in the *Journal Health Affairs* (Sisko et al., 2019). In addition to increased spending, the costs are being transferred in greater portions to consumers/patients. A recent report noted the average deductible paid by individuals with employer-provided health insurance coverage increased from $303 to over $1200 between 2006 and 2015 (Claxton et al., 2018).

Despite the high spending on healthcare, individual and population health outcomes in the U.S. are inferior to other comparable countries in the world. Figure 1 below highlights that changes in life expectancy and disease burden in the U.S. have improved at a slower rate than comparable countries in the world from 1991-2016 with health spending as a share of gross domestic product GDP remaining comparable (Selberg et al., 2018). The noted suboptimal health outcomes and high costs suggests that the value of healthcare in the U.S. has room for improvement. The need for improvement remains when considering more current and complex definitions of value-based healthcare that also include quality, service, access to care, patient centeredness, and guideline concordant and integrated care, in addition to health outcomes and cost effectiveness (Cook et al., 2021; Pendleton, 2018).

Figure 1

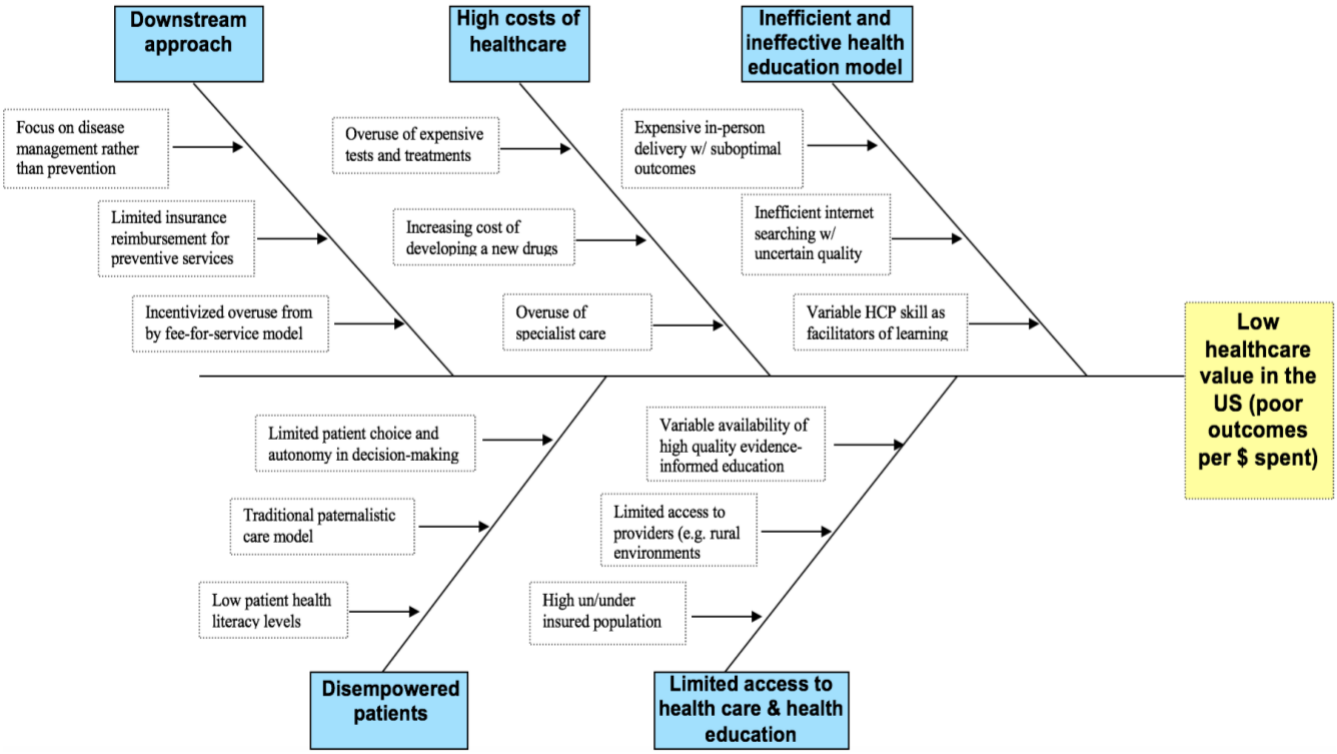
Percent change in life expectancy, disease burden, and health spending as a share of GDP, 1991-2016.



Note. Reprinted from Selberg et al., 2018, Retrieved July 20, 2020 from https://www.healthsystemtracker.org/brief/a-generation-of-healthcare-in-the-united-states-has-value-improved-in-the-last-25-years/#item-start. Reprinted with permission.

Multiple factors contribute to the issue of suboptimal value in our current healthcare system. Figure 2 below is a fishbone diagram (Ishikawa, 1998), also known as a cause-and-effect diagram, which is used to identify root causes. This diagram includes the overemphasis on downstream healthcare services once individuals have already acquired health conditions rather than an upstream proactive approach that emphasizes prevention and addressing social determinants of health (Bharmal et al., 2015). The diagram also highlights system contributions to patient disempowerment (Akeel & Mundy, 2018; Daruwalla et al., 2019), limited access to healthcare and health education (Artiga et al., 2016), and inefficient and ineffective healthcare (Cook et al., 2021; Porter & Teisberg, 2006).

Figure 2 *Causal analysis/fishbone diagram of contributing factors to low value healthcare in the U.S.*



Limited Access to Health Education

In our current healthcare system, when an individual has a health condition, or is at risk of developing one and needs self-management education and/or direct care, two primary options exist: (a) search the internet for health education, and/or (b) schedule face-to-face (FtF) appointments with healthcare providers (HCPs) for in-person guidance. Although the internet provides a valuable medium for accessing health information which can be a particular benefit for underserved populations and individuals living in remote areas, the accuracy and quality of this information is uncertain, unregulated, and frequently highly variable, and the quantity of information can be overwhelming (Veneri & Zdanis, 2018). One of the challenges with using the internet as a resource for patient/client health education is the difficulty discerning what is credible and accurate. Additionally, there is concern about misinterpretation and misutilization of

the information, especially among vulnerable groups with low reading literacy and low health literacy, which is common in immigrant populations (Becerra, Arias, & Becerra, 2017) such as MSAW.

For those who have adequate access and financial resources to utilize FtF health education through direct care with HCPs, the efficiency and efficacy of this traditional delivery of health education may be suboptimal (Bramblett, 2018). Costs and time commitment associated with FtF one-on-one educational delivery are high, and learning outcomes are uncertain and variable (Engel et al., 2009). Third-party health insurance payers have traditionally covered higher percentages of healthcare costs for insured populations but are sharing these costs in greater portions with consumers in recent years due to escalating healthcare delivery costs (Claxton et al., 2018). Although highly personalized one-on-one care delivered FtF may be indicated in many situations, much of the educational content disseminated by HCPs with their clients would be considered to be highly generalizable more so than personalized. I developed the following Figure 3 below to assemble the benefits and challenges of health education delivered via the two noted predominant modes.

Figure 3

Benefits and challenges associated with the predominant delivery modes of the health education component of healthcare

	Benefits	Challenges
In-person FtF education during visits with HCPs	• Education can be personalized to meet individual needs and preferences (Higgins et al., 2020) • Possible higher educational source reliability due to the direct FtF source	• Limited efficiency due to time required to deliver (Rush et al., 2018) • Higher costs (Mo, 2012) • Access limited to those who are willing and able to attend and pay for FtF care (Moattari et al., 2013)
Internet searching with or without direction from HCPs	• Increases access for those not able to attend FtF for various reasons, including geographical barriers or physical limitations (Mo, 2012) • Gives individuals power to access health education at times and places of convenience (Mo, 2012) • Lower costs (Mo, 2012) • Encourages patient empowerment by allowing individuals to play an active role in their health and self-care (De Martino et al., 2017) • Has the potential to reduce health disparities due to easier access (Higgins et al., 2020)	• Some individuals may need and/or prefer more individualized/personalized education, rather than generalized (Higgins et al., 2020) • Limited to those with access to the internet (Mo, 2012) • Requires a sufficient level of digital literacy and health literacy (Lange-Drenth et al., 2021) • Uncertain information quality, and source reliability (Rush et al., 2018)

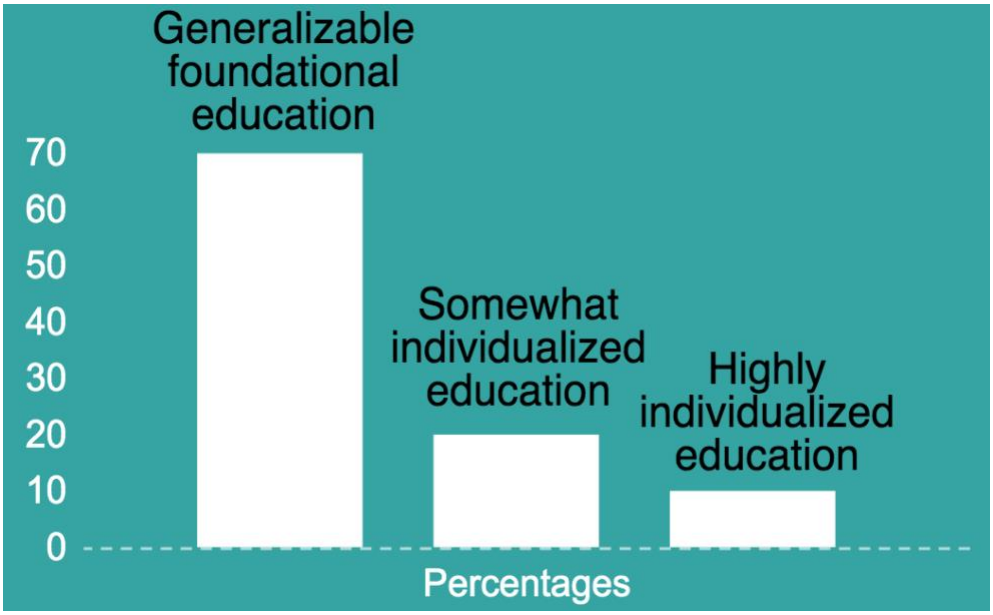
Better self-care health education has been associated with better health through various mechanisms, including increased health knowledge and healthy behaviors and greater perceived control of health (Berkman et al., 2011). As a healthcare provider with over 20 years of clinical experience using the traditional one-on-one FtF model, I have found education to be the most important intervention option that HCPs possess to empower healthcare consumers to take better

ownership and control of their health. During discussions I have had with over 30 HCPs in various health disciplines, I estimate that approximately 60-80% of HCP-directed education is highly generalizable for clients with similar health conditions. I define generalizable health education as education that nearly all individuals with a similar condition would benefit from to improve their health. Generalizable education is not specifically tailored to meet the unique characteristics of the individual. Most generalizable health education could also be considered as "foundational" meaning that individuals may need this basic level of education prior to progressing to understanding more advanced management of their health condition. If individuals do not possess the basic health literacy to understand the foundational issues related to their health, they may struggle to take more ownership and control of their health and health condition (Mantwill et al., 2015).

An example of generalizable and foundational health education can be seen in individuals with non-serious acute or sub-acute low back pain. After ensuring the pain is non-serious, nearly all individuals with this condition should know that this pain will improve over time regardless of treatment for most, that prolonged bed rest is discouraged, and that resuming moderate activity as soon as possible is generally advisable. The criteria for determining when low back pain is serious and non-serious could also be considered generalizable and foundational. Figure 4 below is a theorized visual representation I created that estimates the health literacy levels of HCP-directed education based on my own experience and the informal conversations I have had with other HCPs referenced above. Approximately 70% (or between 60% and 80%) of education can be categorized as "generalizable foundational" or "basic", 20% as "somewhat individualized/personalized", and 10% as "highly individualized."

Figure 4

Theorized estimate of the level of typical health education delivered by HCPs during FtF visits



When considering the efficacy of HCP-directed education delivered through traditional in-person FtF clinical visits, provider time is often limited, and visits can feel rushed. In a study measuring the amount of time primary care physicians interacted with older adult patients in an outpatient setting, the average total time was 15.7 minutes per patient (Tai-Seale et al., 2007). An average of only 1.1 to 5 minutes of the 15.7 minutes was allocated to address an average of six different health-related topics. Additionally, Stull and Duvivier (2017) suggest that patient education may be the most effective tool possessed by HCPs, but that traditional HCP education models may not be adequately preparing future HCP to "teach" or meet the educational needs of patients. Additionally, HCPs commonly communicate at a high health literacy level using academic and/or medical terminology that inadvertently may exceed the capacity of patients to comprehend (Graham & Brookey, 2008). Thus, many HCPs may not be using optimal teaching and learning strategies with their patients, which may ultimately hinder health improvements in the populations they serve.

From the perspective of the healthcare consumer, clinical settings may not be ideal environments for learning, as they can be fast-paced, stressful, and distracting, which may negatively influence learning. Additionally, consumers of healthcare are commonly receiving services for health conditions that negatively influence their physical, emotional, and/or cognitive states. Symptoms such as pain, discomfort, and anxiety, along with the side-effects of medications, can negatively influence mood, alertness, and cognitive function, all of which can hinder learning. In my own experiences as an HCP and from informal conversations I have had with over 30 HCPs, estimates are that consumers retain less than 20-40% of HCP delivered education after healthcare visits intended to improve knowledge and skills acquisition.

Health education is considered a key component of patient empowerment, which has been variably defined, but is generally understood to refer to an approach to patient-centered care that seeks to maximize patient autonomy, power, and control over their own health (Werbrouck et al., 2018). The traditional relationship between HCPs and patients in the U.S. has been referred to as more paternalistic and less of a partnership, with HCPs viewed as the experts who expect patients to be "compliant" with the care recommendations they are prescribed (Bridges et al., 2008; Daruwalla et al., 2019). The concept of patient empowerment, however, seeks to transform the HCP-patient relationship into more of a partnership where the patient is more confident and involved in their care through a shared decision-making model (Akeel & Mundy, 2018). Patient education is the most common approach to empower patients, as education is generally believed to help patients make more informed decisions, improve adherence to treatment recommendations, and improve active participation in self-care (Calvillo et al., 2013).

HCPs can facilitate patient empowerment by helping patients receive the necessary knowledge, skills, and insights to help them make more informed decisions that help improve

their health. Calvillo et al. (2013) concluded that the three most valued ways to empower patients is to improve (a) health literacy, (b) remote access to health services, and (c) self-care capacity. These authors also concluded that Information and Communication Technologies (ICT) have the potential to positively influence each of these domains of empowerment (Calvillo et al., 2013).

The noted challenges related to inadequate access to and inefficient delivery of health education are even more concerning when considering health disparities between different populations in the United States (U.S.). Health disparities, or health inequities, are differences in health and health outcomes between populations linked to social, economic, and/or environmental disadvantages (U.S. Department of Health and Human Services, 2016). Health disparities indicate unjust and avoidable differences in health-related outcomes. Race, ethnicity, gender, sexual orientation, age, disability status, socioeconomic status, and geographic location can all shape an individual's ability to achieve optimal health (U.S. Department of Health and Human Services, 2016).

In the U.S., people from minority racial groups, from lower socioeconomic status levels, and from more rural areas suffer disproportionate burdens of health conditions (Thomas et al., 2014). People of color, including Hispanics, African Americans, American Indians, and Alaska Natives, face increased barriers to accessing care, are more likely to be uninsured and have lower utilization of care than white Americans (Artiga et al., 2016). Living in remote areas also contributes to lower access to care (Artiga et al., 2016). According to the Centers for Disease Control and Prevention, prevalence of the five leading causes of death in the U.S. are all higher in rural communities, which includes heart disease, cancer, unintentional injury, chronic lower respiratory disease, and stroke (Garcia et al., 2017). With the link between better education and improved health outcomes, finding better and more cost-effective ways to increase access to

quality health education may help address the noted health disparities in the most vulnerable populations.

Problem Two: Limited Access to Healthcare and Health Education in Migrant and Seasonal Agricultural Workers

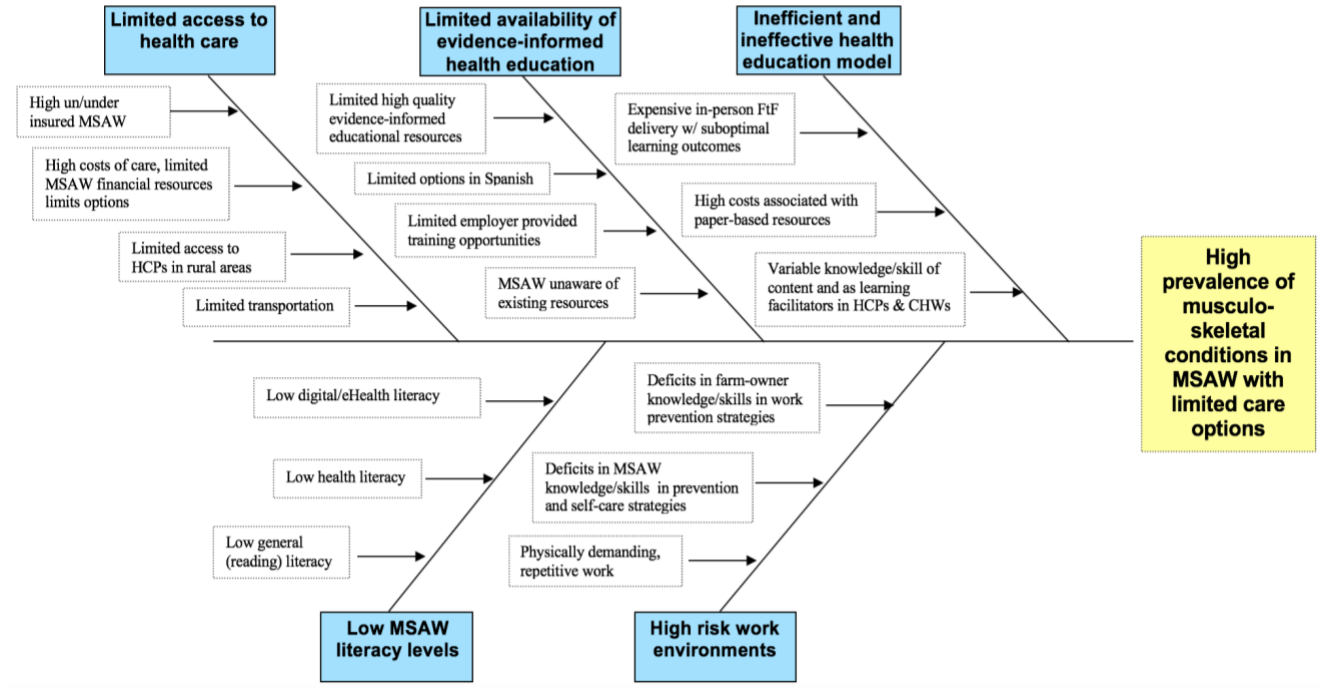
One particularly vulnerable population is migrant and seasonal agricultural workers (MSAW). Agricultural work is one of the most hazardous occupations in the U.S. with a fatality rate in 2016 of 23.1 per 100,000 workers, compared with an overall industry rate of 3.6 per 100,000 (U.S. Bureau of Labor Statistics, 2017). The work is physically demanding, and workers are at risk for a variety of health-related problems, both psychological and physical. MSAW typically work long days in variable weather conditions performing strenuous, repetitive tasks in awkward postures. Musculoskeletal injury and pain are common among all industries but occur more frequently among agricultural workers (U.S. Bureau of Labor Statistics, 2017). According to the National Institute for Occupational Safety and Health (2018), an average of 167 agricultural workers per day suffer a lost-work-time injury, with an estimated 50% occurring due to musculoskeletal sprains and strains (2018). Especially for migrant workers who are away from their families with few support mechanisms, depression, anxiety, substance abuse and sleep disorders are prevalent (Arcury et al., 2012; Ellegard & Pederson, 2012; Hiott et al., 2008; Sandberg et al., 2012). Research suggests an association between psychosocial factors, depression, sleep disorders and musculoskeletal pain (Osborne et al., 2012; Sandberg et al., 2012).

Despite the high incidence and prevalence of musculoskeletal health issues, MSAWs face a number of barriers to accessing healthcare and health education in the U.S., which are issues of justice and health equity. These barriers are highlighted in a Fishbone causal analysis diagram

(Doggett, 2005) in Figure 5 below, which include limited financial resources, limited English language proficiency, low general (reading) literacy and health literacy levels, lack of authorization to work and reside in the U.S., limited insurance and worker's compensation coverage, and limited transportation. Additionally, MSAW commonly live in rural areas that have low geographic densities of HCPs and a scarcity of specialty care providers (Arcury et al., 2012; National Center for Farmworker Health, 2018). Because of these noted challenges to accessing healthcare and health education, improving MSAW access to preventive and self-care education has even greater relevance, as this may be the only feasible option for many to address the noted high health-associated risks.

Figure 5

Fishbone causal analysis diagram of contributing factors to MSAW musculoskeletal health conditions in the U.S.



The state of North Carolina has approximately 80,000 MSAW according to the North Carolina Department of Commerce (Freeman Lambar & Thomas, 2019). Various health agencies at the regional, state, and national levels work to meet the unique needs of MSAW, including working to address the noted musculoskeletal health issues. In North Carolina, this includes the North Carolina Farmworker Health Program (NCFHP), which receives federal funding to provide health education and health services to uninsured and underinsured MSAW. Typically, the NCFHP, through various sub-agencies, helps train community health workers (CHW), who are lay trained health outreach workers, to travel to farms, agricultural living quarters, and regional health clinics to provide basic in-person FtF health education. CHWs and partnering HCPs may also perform screening examinations during outreach visits to identify individuals

with more serious health conditions that warrant specialist evaluation and care. FtF education is commonly supplemented with printed written materials. CHW typically receive minimal training specific to addressing musculoskeletal health issues associated with agricultural work, although exact amounts were not identified in the literature. At the national level, organizations like the Migrant Clinicians Network (MCN) provide additional training opportunities for HCPs who work with MSAW and other migrant populations.

The governance structures within organizations such as the NCFHP and the MCN are variable, but typically involve having a director who oversees all operations, along with educational coordinators who lead most CHW education training efforts. The NCFHP typically holds two to three day in-person basic training sessions with new CHWs once a year in June, along with supplemental training once a year in March/April for all NCFHP employees. Additional informal on-the-job training occurs with guidance from coworkers. Attendance at the mentioned NCFHP trainings are typically mandatory. At the time of implementation of this disquisition work, the NCFHP did not have a learning module related to musculoskeletal health for MSAW.

Because nearly three-quarters of MSAW report Spanish being the language in which they are most comfortable conversing (U.S. Department of Labor, 2016), most printed health education materials distributed by CHWs and HCPs are in Spanish. However, although exact reading literacy rates are not known and were not included in the findings from the National Agricultural Workers Survey (NAWS) 2013-2014, the average level of formal education completed by MSAW was eighth grade with approximately 40% reporting the sixth grade or less as the highest grade completed (U.S. Department of Labor, 2016). This low level of formal education may limit the effectiveness of written education, especially materials that require high

health literacy levels for comprehension. Additionally, evidence for learning efficacy using printed educational materials with MSAW is limited. Specifically related to musculoskeletal health education, it is not known what percentage of MSAW in the U.S. receive this education. In 2015 in western North Carolina, only 29% of MSAW reported receiving any occupational training related to musculoskeletal injury risk reduction (Carzoli et al., 2015). However, it is unknown what this occupational training involved or how it was delivered. For MSAW who do receive musculoskeletal health educational training, it is unknown how well they learn and apply any knowledge gains to practice, or whether any potential improvements in knowledge, skills, attitudes, and behavior ultimately influence musculoskeletal health risk reduction and health outcomes.

Theory of Improvement

A working theory of improvement aims to introduce a change that seeks to address one or more of the issues identified in the causal system analysis (Byrk et al., 2015). As noted previously, this disquisition explores a theory of improvement aimed directly at inadequate access to healthcare and health education for MSAW. However, this proposed model of improvement has larger implications related to the institutional problem described as suboptimal value in healthcare. The broader potential implications of the improvement initiative are described first, followed by implications in the agricultural health realm.

My theory of improvement holds that hybridizing the health education component of healthcare by using various combinations of synchronous face-to-face (FtF) and asynchronous video-based education using technology that includes learning management systems will ultimately improve MSAW health outcomes and increase healthcare value by (a) increasing

access to evidence-informed health education, (b) enhancing learning outcomes, and (c) demonstrating value with respect to health outcomes, perceptions of care, and costs.

A team of physicians recently reported that great potential exists for improving health outcomes through improved patient education and self-care models considering future projections of continued increases in healthcare costs, (Paterick et al., 2017). These physicians highlighted the importance of improving patient health literacy through better patient education and engagement as key components of more complete self-care management and more responsible healthcare utilization (Paterick et al., 2017). In a systematic review intended to better define health literacy, Sørensen et al. (2012) described health literacy as the following:

> Health literacy is linked to literacy and entails people's knowledge, motivation, and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course (p. 3).

The previously described predominant mode of health education delivery between HCPs and patients in our current healthcare system typically occurs either during one-on-one FtF sessions, which are commonly supplemented with written materials, or via internet searching by consumers/patients. Figure 6 below is a process chart illustrating this traditional delivery mode of health education for individuals with health education needs. In this model, minimal preventive health education typically occurs prior to the development of a health condition. Although consumers of healthcare commonly have access to the internet to search for self-care education, this search process can be inefficient due to the high amount of information available on the internet. Internet searching can also be ineffective as the quality and reliability of

available information can be difficult to ascertain for many consumers. Therefore, consumers commonly schedule visits with HCPs to diagnose their condition and to receive treatment recommendations, which typically include some level of health education. For individuals who are uninsured, underinsured, or have limited financial resources, options for FtF visits with HCPs can be challenging due to the high costs of healthcare. Individuals who live in rural areas with low densities of available HCPs, including specialty providers, may also find their options limited. As previously noted, the efficacy of this traditional FtF model is uncertain even for individuals who have available financial and insurance resources to visit HCPs in person.

Figure 6

Current theorized predominant model of the health education component of healthcare

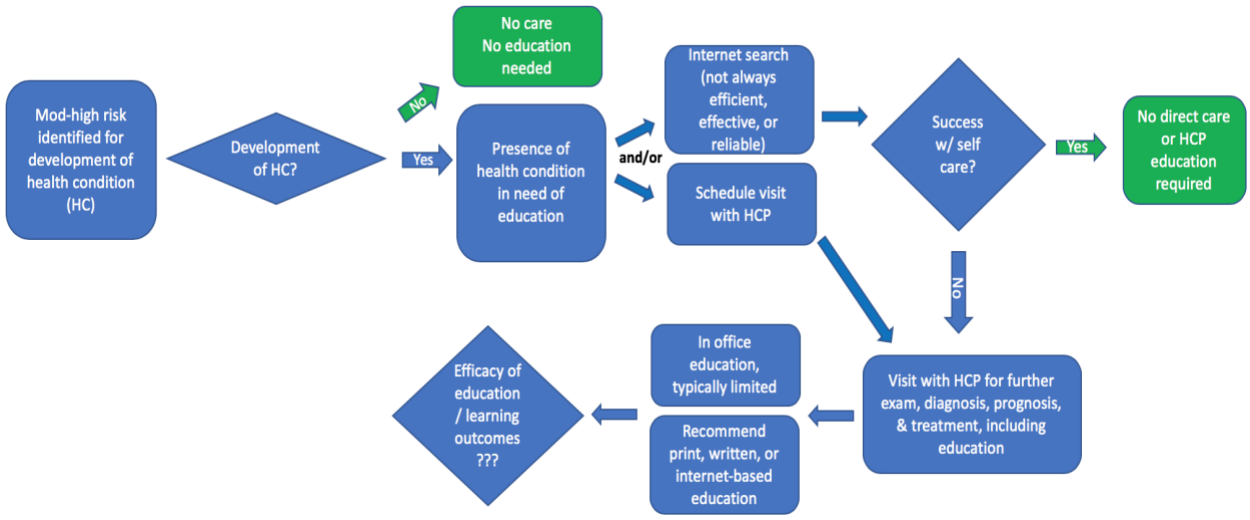
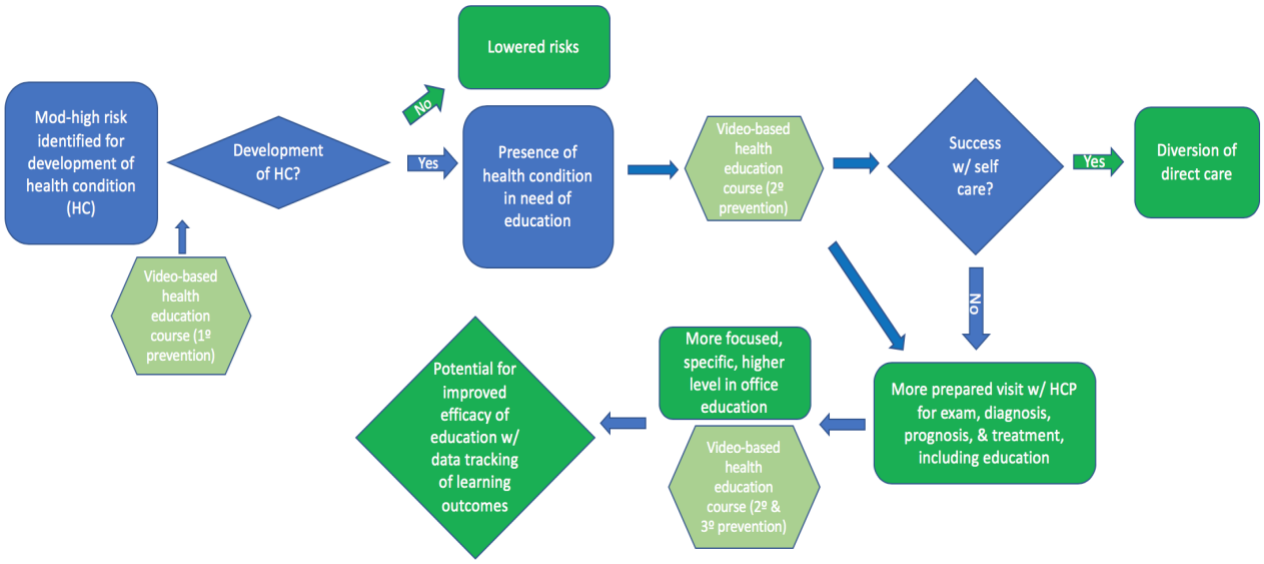


Figure 7 below illustrates a proposed process improvement model intended to increase the availability/access of evidence-informed health education that emphasizes prevention and self-care to both individuals who are at risk of developing health conditions and those who have already developed conditions. In this proposed model, high quality evidence-informed education is made available to healthcare consumers both before they develop a health condition for preventive purposes, and also once they have developed a health condition for the purpose of

empowering self-care by building foundational health literacy to better understand and manage their condition. This model proposes that in many situations, more expensive FtF visits with HCPs can be either reduced in cases where patients are more informed and more empowered to self-manage their conditions, or completely eliminated in cases where prevention and self-care education help mitigate or resolve their conditions. In situations where FtF visits with HCPs are still indicated, this model proposes that improvements in patient health literacy will improve the efficiency and efficacy of visits with providers, allowing the HCPs to focus their expertise on providing more personalized/individualized care and education rather than generalizable foundational education that can be time-consuming to deliver.

Figure 7

Proposed theorized improved model of the health education component of healthcare



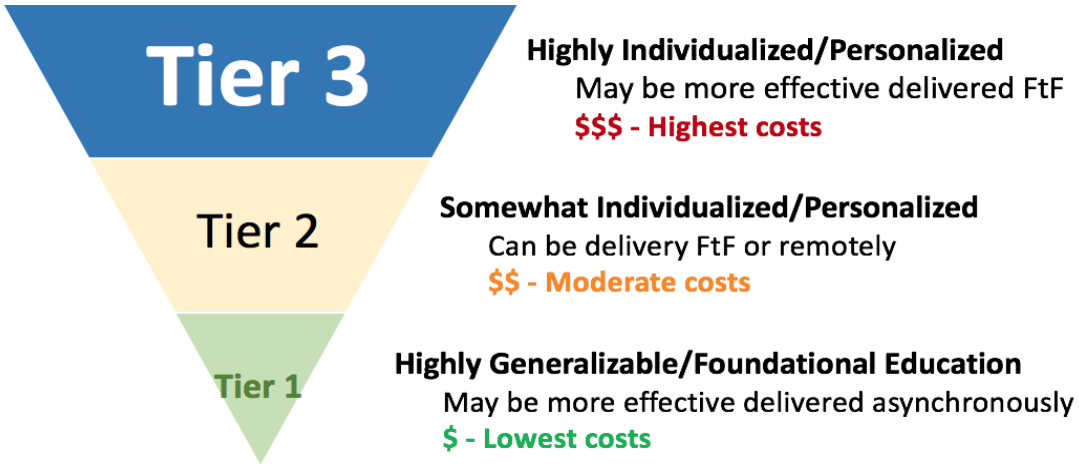
As previously noted in Figure 4 above, it is estimated that approximately 60-80% of health education delivered by HCPs is considered to be at the "foundational" level. Because most foundational education is considered to be highly generalizable, it is feasible that it could be delivered and consumed best in an asynchronous manner at times and places of convenience for

healthcare consumers. Asynchronous educational formats also enable learners to learn at a pace that is best for their individual learning needs (Mo, 2012).

I designed Figures 8 and 9 below to provide a visual representation of our current model of health education delivery (Figure 8) and a proposed model (Figure 9) described in three tiers. Tier 1 represents “highly generalizable/foundational education” that may be best delivered asynchronously. Tier 2 represents “somewhat individualized/personalized education” that may be best delivered in various combinations of asynchronous remote and synchronous FtF forms. Tier 3 represents “highly individualized/personalized” education best delivered during FtF visits with HCPs. As noted in these figures, the costs are presumed to be highest in Tier 3 and lowest in Tier 1. In our current healthcare model, the majority of care and education are believed to occur in Tier 3 followed by Tier 2, with Tier 1 being vastly underutilized. Alternatively, the conceptual model in Figure 9 proposes to flip this model by prioritizing and increasing access to Tier 1 foundational generalizable health education.

Figure 8

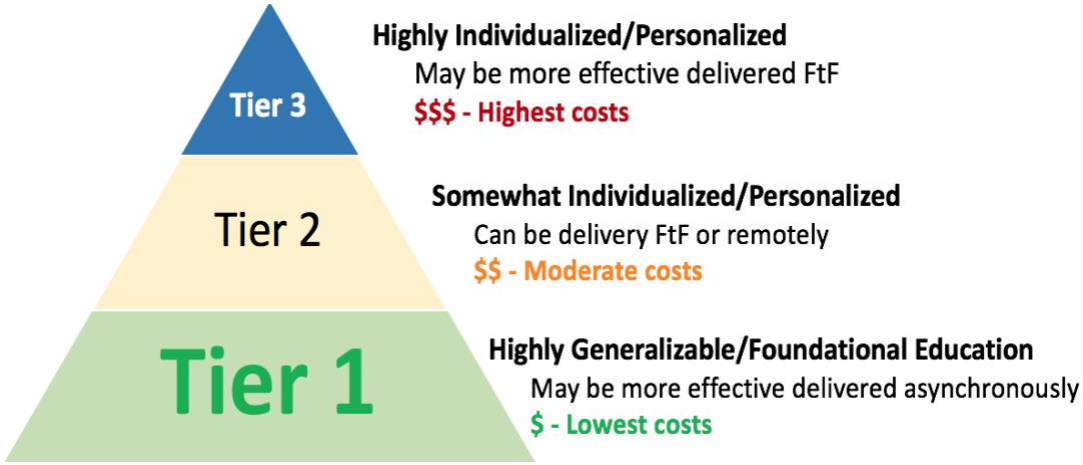
A conceptual model of our current healthcare education delivery system



Note. Although Tier 3 health education which is typically occurs FtF between patients and HCPs provides highly individualized education, costs are theorized to be highest.

Figure 9

A conceptual proposed model of healthcare education delivery system



Note. In this proposed model, Tier 1 education is prioritized, which involves increasing access to asynchronous generalizable/foundational health education. Although not highly individualized, costs associated with Tier 1 education are theorized to be significantly lower than Tier 3.

The proposed model described in Figure 9 has the potential to increase healthcare value by maintaining or improving health outcomes while lowering costs. Additionally, by potentially reducing the time and energy HCPs spend providing foundational/generalizable education, it could free up time to provide highly individualized/personalized education and care when necessary. In doing so, it would promote the idea of HCPs practicing at the "top of their licenses" which permits HCPs to use their high level of knowledge and skills to provide highly individualized/personalized and/or specialized care when needed, while allowing the foundational/generalizable education to be developed using evidence-informed best practices in both the health and education sectors. This model acknowledges that necessary levels of fluidity/adaptability may be required to allow HCPs to determine the optimal ratio combinations of Tier 1, 2, and 3 educational deliveries based on various contextual circumstances that include but are not limited to individual client needs and preferences.

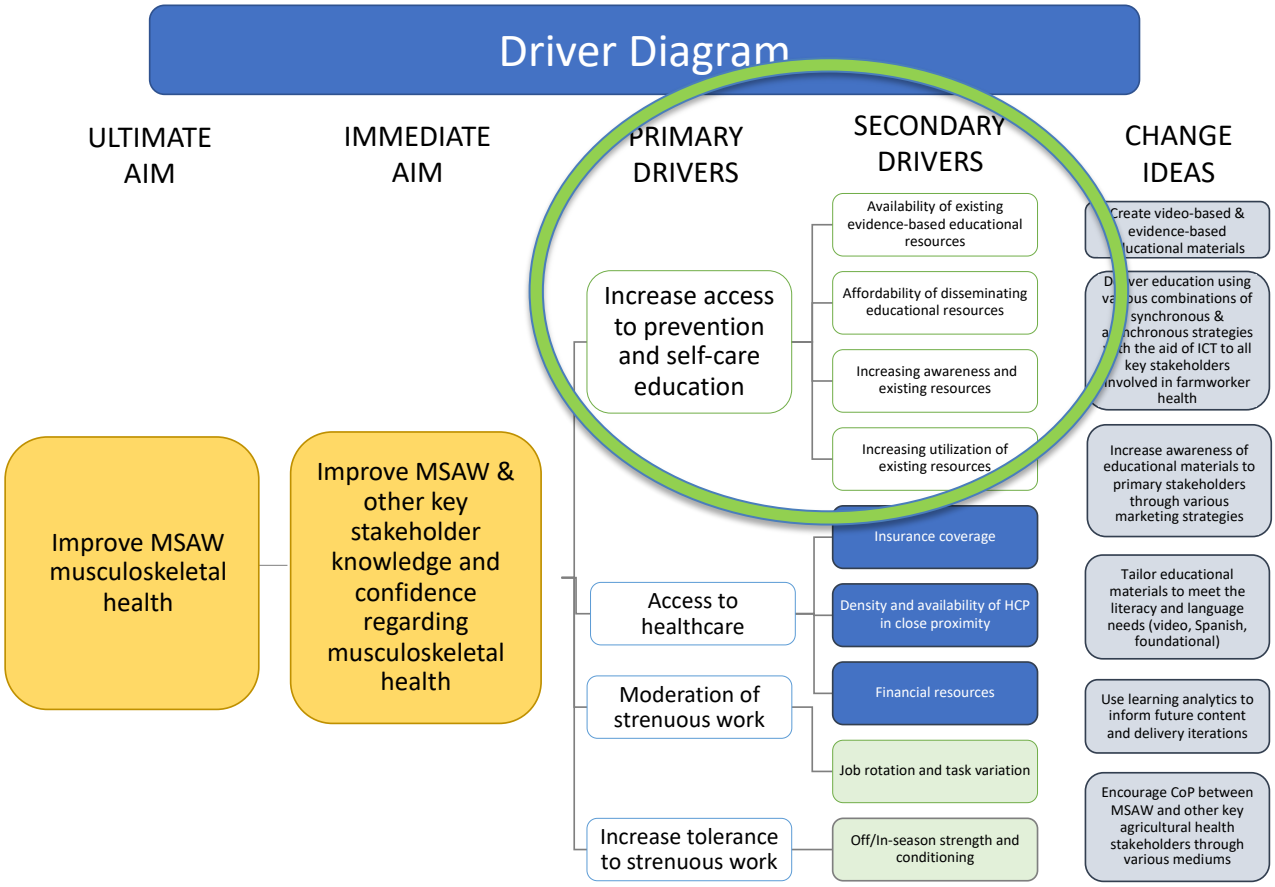
In the context of MSAW, *my theory of improvement holds that hybridizing the delivery of musculoskeletal health education for key stakeholders involved in agricultural health, including MSAW, CHWs, HCPs, farm owners, and agriculture crew leaders will assist in (a) improving knowledge and confidence regarding prevention, self-care, and management of common musculoskeletal (MSK) health issues associated with agricultural work, (b) increasing access to evidence-informed health education that emphasizes prevention and self-care, and (c) demonstrating value with respect to health learning outcomes and perceptions of effectiveness of the educational content and delivery.*

Figure 10 below is a driver diagram (Byrk et al., 2015), which represents a theory of practice improvement with the ultimate aim of improving MSAW musculoskeletal health. The immediate aim of the improvement initiative is to improve MSAW & other key agricultural

health stakeholders knowledge and confidence regarding musculoskeletal health by increasing access to (primary driver) and awareness and utilization of (secondary drivers) foundational musculoskeletal health education that emphasizes prevention and self-care. The primary and secondary drivers thought to be associated with achieving the ultimate aim are identified in the green circle in the diagram.

Figure 10

Driver diagram with the ultimate aim of improving MSAW musculoskeletal health



Literature Review of the Improvement Initiative

The following review of the literature seeks to highlight the current state of evidence related to the proposed theory of improvement described above of hybridizing the delivery of musculoskeletal health education for key stakeholders involved in agricultural health. Although

some of the cited literature falls in the immediate domain of the proposed improvement initiative, the review also includes literature in related but different domains where studies are limited in the immediate domain. This includes the use of eHealth and eLearning/online learning in various educational settings, including academia and healthcare.

eHealth and eLearning Definitions

The use of eHealth, defined by the World Health Organization (n.d.) as "the use of information and communication technologies (ICT) for health", has grown in recent years in attempts to improve health outcomes, especially for populations living in remote areas with limited access to healthcare and health education. Electronic learning, or eLearning (also referred to as "online" learning), which is the application and integration of electronic technology in education, including media and devices, is a component of eHealth that can be used to increase access to health education. eLearning may occur synchronously and asynchronously. Synchronous eLearning occurs when distance education happens in real time, whereas asynchronous eLearning occurs when distance education is delivered through remote mediums without real-time FtF interaction. Hybrid learning models blend asynchronous and synchronous learning mediums. Learning management systems can be used to help organize and deliver online eLearning materials and activities which permit individuals to access educational materials on-demand at times and locations of convenience. Additionally, video-based learning materials may improve accessibility for individuals with low general (reading) literacy. eLearning and eHealth strategies have the potential to improve accessibility and lower costs for individuals who live in remote areas or have limited financial resources.

Evidence for eLearning

Strong evidence exists for the efficacy of eLearning in traditional higher education environments when compared to FtF learning, with outcomes generally demonstrating eLearning to be at least as effective as FtF learning (Nguyen, 2015; Stack, 2015). Nguyen (2015) concluded that future research should move beyond the basic comparison with traditional education into more advanced areas of online learning optimization. Similar conclusions have been reported on the efficacy of eLearning for undergraduate professional education in the health sciences in a systematic review published by the World Health Organization (Al-Shorbaji et al., 2015). This review concluded that eLearning outcomes related to knowledge and skill acquisition can be equal or superior to traditional learning and may also be a more convenient and cost-effective way to train healthcare professionals around the world (Al-Shorbaji, et al., 2015).

Studies investigating eLearning strategies that indirectly target individuals with health conditions by educating health outreach workers (also known as community health workers (CHWs)) and/or caregivers have also generally reported positive learning outcomes (Jones & Lacroix, 2012; King et al., 2018; Ledoux et al., 2018). A randomized controlled trial piloting the efficacy of an online video-based learning program for parents of children at risk for obesity reported positive outcomes related to perceived acceptability of the education, learner engagement, and knowledge and belief changes (Ledoux et al., 2018). The authors emphasized the importance of using a community-based participatory research methods model to develop the video-based educational materials. Similarly, an eLearning approach related to management of chronic pain in the classroom of children ages 8-18 resulted in positive outcomes in terms of usability in a group that included both parents of youth with chronic pain and their teachers (King et al., 2018). A randomized controlled trial intended to assess the influence of delivering

online video-based education in a soap opera format on HIV risk reduction in young urban African American women using smartphones concluded that video-based learning has the potential to improve educational intervention effectiveness via improved learner engagement from multimedia, along with improved distribution by standardizing the delivery model (Jones & Lacroix, 2012).

Published studies investigating the use of eLearning directly targeting healthcare consumers/patients are more limited. A systematic review published in 2018 concluded that virtual education delivered via a variety of telehealth modalities that included the internet, telephone, video conference, and television administered to patients with common chronic conditions such as diabetes and chronic obstructive pulmonary disease, were comparable or superior to usual care (Rush et al., 2018). Another literature review published in 2018 concluded that mobile health technologies can help improve health education in historically underserved and minority populations (Anderson-Lewis et al., 2018). This review also cited recent trends indicating increased smartphone adoption rates in populations experiencing the highest rates of health disparities in the U.S (Anderson-Lewis et al., 2018). In a quasi-experimental design study that compared eLearning to traditional classroom education for HIV/AIDS prevention in adolescents in South Africa and Ireland, the investigators reported superior knowledge gains and internalizing in the eLearning group (van Zyla et al., 2014). Nikolaou et al. (2015) noted positive preventive measures against weight gain in the young adult population in two experimental groups that participated in a 40-week eLearning program compared to a control group in a randomized controlled trial. This evidence, although limited, suggests there are potential benefits of eLearning delivered directly to consumers of healthcare. However, additional research is needed in this area.

Potential Value of eLearning

The World Health Organization suggests that technology-mediated learning can also help reduce costs for both HCPs and their patients (Al-Shorbaji et al., 2015). A study that compared the delivery costs of traditional FtF education with a blended eLearning approach with CHWs reported a reduction in costs by as much as 67% (Sissine et al., 2014). Because online delivery of health education has the potential to offer lower cost and higher value solutions for various health conditions, eLearning courses could be distributed by HCPs, insurance companies, and large organizations interested in offering these to their patients, customers, and/or employees as a means of providing prevention and self-management education as a first option of care. Commonly, higher cost and risk tests, treatments, and educational strategies are utilized first for many health conditions, whereas lower cost and risk options may be equally effective as an initial care strategy. Additional potential benefits of evidence-based eLearning health education are standardizing educational content quality and delivery as well as permiting broad educational dissemination in a cost-effective manner.

Hybridization of eLearning

Although asynchronous health eLearning can be used as an isolated educational tool by itself, it may be most effective when coupled in a hybrid manner with synchronous education delivered FtF or via telehealth with learning facilitators such as HCPs and CHWs. Learning in both of these forms can largely be classified as *learning-as-acquisition*, which focuses on the attainment of knowledge, skills, and attitudes (Morris, 2018). In addition to learning-as-acquisition, the use of eLearning for health education has the potential to promote *learning-as-participation* through community networks and social practice, commonly referred to as Communities of Practice (CoPs). CoPs refer to “groups of people who share a concern or a

problem and who come together to interact, learn and create a sense of identity, and in the process, build and share knowledge and solve problems" (Ranmuthugala et al., 2010). CoPs may be used as a means of applying gains in knowledge, skills, and attitudes to everyday health practices.

Generalizable, Contextually Relevant Education

An important consideration in delivering health education via eLearning is ensuring that generalizable education is relevant for consumers, which may necessitate having a diagnosis determined by an HCP in some cases. When feasible, generalizable health education should also be sufficiently tailored to meet the specific contextual needs of individuals. Findings from a study by Ndosi et al. (2015) suggests that needs-based education directed specifically towards the educational needs of clients helps improve patient self-efficacy and some aspects of health status more than generalized education that may not adequately target the educational needs of individuals. Related, Yee et al. (2018) recommended that population health improvement initiatives shift from patient-centered care to patient and context driven care.

Video-based health education as a component of eLearning may be an effective method for ensuring the education is tailored to meet the unique cultural, linguistic, health literacy, and general literacy needs of many populations with noted health disparities, including MSAW. However, it may have limitations with respect to providing highly individualized and contextualized education that meet certain unique aspects of personalized care.

Learning Management Systems as a Platform for Health Education eLearning

A variety of eLearning forms in the literature cited above have been used in various settings. However, few studies describe the use of more sophisticated means of both delivering and managing eLearning with consumers of health (patients), such as using a Learning

Management System (LMS). LMSs provide a means of delivering education and tracking participant use, learning, and other outcomes in a manner that is typically easily accessible for remote learners, including access through smartphones. LMSs have the potential to be an effective method for wide dissemination of health education in a cost-effective manner. Because learners typically use a login process to engage in the learning materials, it is possible to evaluate various types of analytical data that may be useful for patients and other key stakeholders in healthcare.

Addressing Health Inequalities and Inequities/Disparities

Improving the delivering of health education may serve particularly useful for populations with noted health disparities in the U.S., including but not limited to people from minority racial groups, from lower socioeconomic status levels, and from more rural areas, who suffer disproportionate burdens of health conditions (Thomas et al., 2014), and face increased barriers to accessing care (Artiga et al., 2016). The use of technology, information and communication technology (ICT) in particular, is viewed as a means of both improving health outcomes and reducing health inequalities and inequities commonly associated with population health and healthcare (Marschang, 2014). However, ICT, in its current state of use, may be more effective at addressing health inequalities than health disparities, and could potentially widen the disparity gap if key components are not included in the care delivery model, especially for vulnerable populations (Yee et al., 2018).

Improvement Methodology/Design

The model for this improvement initiative was grounded in various key aspects of improvement science informed by Langley et al. (2009). The model includes seeking to answer the following three fundamental questions that guide improvement efforts: (a) What are we

trying to accomplish?, (b) How will we know that the change is an improvement?, and (c) What change can we make that will result in improvement? (Langley et al., 2009). An additional key component of improvement science is the utilization of Plan-Do-Study-Act (PDSA) cycles. Short PDSA cycles provide structure for evaluating change that is then used to guide further change ideas aimed at continuous learning for improvement. Because improvement science is highly iterative in nature, multiple PDSA cycles are typically necessary to gather sufficient data to adequately inform and test additional change ideas. The model encourages choosing manageable change processes, targeting specific measurement variables, and controlling timeframes for each cycle (Langley et al., 2009). Practical measurements can be used to track changes in various aspects of the improvement initiative. This improvement initiative employed these tenants of improvement science and others as a medium for guiding purposeful change.

Design Team

As a scholar practitioner, I served as the team lead. Scholarl practitioners have a unique role in working to bridge the gap between academic insight (scholarly) and the practical application of this insight to complex problems of practice in their area of work (practitioner). Of note for this disquisition work was that I carried out the work in the agricultural health education arena and not in my primary domain of work which is doctor of physical therapy education in the university setting. Despite having over eight years of experience partnering with agricultural health agencies in the work associated with this disquisition, I acknowledged the potential positionality challenges of leading change as a more remote insider from the practitioner perspective. Additionally, the individuals noted below served as members of the design team for this improvement initiative as contextual and practical design and implementation advisors:

1. Marianne Martinez, Executive Director, Vecinos Farmworker Health Program. Mrs. Martinez provided general guidance on the educational content, delivery format, and dissemination strategies aimed at MSAWs and CHWs.
2. Robin Tutor-Marcom, EdD.; Director of the NC Agromedicine Institute affiliated with East Carolina University. Dr. Tutor-Marcom comes from a family of farmers and has close relationships with farmers throughout North Carolina. She provided general guidance on the educational content, delivery format, and dissemination strategies aimed at farm owners and the agricultural health community.
3. Jessica Rodriguez, Outreach Coordinator, Vecinos Farmworker Health Program. Ms. Rodriguez's parents migrated from Mexico and worked as farmworkers during her youth. She provided general guidance on the educational content, delivery format, and dissemination strategies aimed at MSAWs and CHWs.
4. Robert Bellemy, Operations Manager, and Nick Wind-McJetters, Senior Solutions Architect with Elearing Experts. Mr. Bellemy and Mr. Wind-McJetters served as online learning and instructional design advisors.
5. MSAW served by Vecinos Farmworker Health Program provided feedback on the perceived utility of the educational content and delivery medium.

Improvement Initiative

This improvement initiative built on prior work I developed in collaboration with various other key stakeholders involved in health education and agricultural health. This work included creating video-based preventive musculoskeletal health educational materials for two primary groups involved in agricultural work: (a) key stakeholders in agricultural health which includes CHWs, HCPs, farm owners, and agricultural crew leaders, and (b) MSAW. These materials were

created in collaboration with MSAW, farm owners, agricultural health and safety organizations, doctor of physical therapy students, and other key stakeholders involved in agricultural health in North Carolina. The educational content was created to be contextually relevant, and culturally and linguistically appropriate. For this reason, the first course was delivered in English based on feedback from the agricultural health community while the second course intended for MSAW was delivered in Spanish. Evidence-informed decisions were made throughout the development of these materials and in the selection of teaching and learning strategies. Valuable perspectives from CHW, MSAW, and the Executive Director of Vecinos were also incorporated into the educational content.

The educational content for each of the two intended audiences was organized into two separate online courses in Moodle, which is an open-source LMS. Additional guidance on organizing the educational materials in the LMS was provided by eLearning consultants employed by Elearning Experts. Financial contributions for these consultations were provided via a grant from the Southeast Center for Agricultural Health and Injury Prevention (SCAHIP) at the University of Kentucky, which is a NIOSH (National Institute for Occupational Safety and Health) funded research center. The courses were accessible using most digital electronic mediums as long as internet services were available via laptop computers, smart phones, or another electronic device such as a tablet. In the absence of immediate internet services, course materials could be pre-downloaded and stored on an electronic device in a location where internet was available, and then viewed in locations without internet through stored data on the device.

In order to access either of the courses in the LMS, participants were required to register by entering their name and a valid email address. Participants were also required to create a

password. Permitting easier access to the courses in the LMS by not requiring registration with the noted personal information was possible. However, doing so would limit the ability to track individual learning analytics and learner progress in the courses.

Implementation of the Improvement Initiative

Initial Implementation Timeline

Figure 11 below provides an overview of the initially proposed implementation timeline. The timeline highlights the key implementation activities that were initially planned in each of the proposed PDSA cycles.

Figure 11

Initial Proposed Implementation Timeline

Implementation Plan/Timeline	April 2019	January 2020	February	March 2020	April	May	June	July	August	September	October	November	December 2020
Finalized educational courses in LMS	x												
Make courses available after internal piloting	x												
Communicate course release via e-mail	x												
End of PDSA 1				x									
Data evaluation by design team				x									
Social media effort to increase awareness				x									
End of PDSA 2						x							
Data evaluation by design team						x							
Additional modifications to course design/ dissemination based on PDSA 2						x							
End of PDSA 3								x					
Data evaluation by design team								x					
Additional modifications to course design/ dissemination based on PDSA 3								x					
Semi-structured interviews with key stakeholders								x					
End of PDSA 4										x			
Final course data evaluation											x		
Final data evaluation (all)													x

Actual Implementation Timeline

The actual implementation period was extended in part due to the global COVID-19 pandemic that contributed to a shift in priorities in the agricultural health work environment and also in the daily actions and behaviors of people throughout the world. Agricultural health agencies made a significant shift in their educational priorities to address issues related to the pandemic in the farmworker population. Thus, less attention was given to non-COVID-19 health issues, including those related to musculoskeletal health. Additionally, the initial plan had intended to combine asynchronous educational delivery methods with FtF educational delivery sessions for both intended audiences. However, FtF delivery was not possible due to mandated social distancing practices during the pandemic. The actual implementation timeline is included below in Figure 12.

Figure 12

Actual Implementation Timeline

Implementation Timeline	April 2019	January 2020	February	March	April	May - Oct	November	December	January 2021	February	March	April	May	June 2021
Finalized educational courses in LMS	x													
Courses made available after internal piloting	x													
Communicated course release via e-mail	x													
End of PDSA 1				x										
Data evaluation by design team				x										
Social media effort to increase awareness					x									
End of PDSA 2							x							
Data evaluation by design team							x							
Semi-structured interview with key stakeholder							x							
Promoted course links on NCFHP webpage							x							
End of PDSA 3										x				
Data evaluation by design team											x			
Semi-structured interview with key stakeholder											x			
National conference presentation to increase course awareness											x			
End of PDSA 4														x
Final course data evaluation														x
Final data evaluation (all)														x

Goals of the Improvement Initiative

Although the driver diagram in Figure 10 explicates the long-term/ultimate aim of this work (to improve MSAW musculoskeletal health) I did not expect to achieve that goal within the period of the time allotted for the disquisition process. I did, however, intend to accomplish the immediate goal(s).

Consistent with Figure 10, noted in the solid green colored items, the goals related to the achieving the immediate aim and the primary/secondary drivers for both mentioned targeted groups were:

1. To improve knowledge and confidence related to prevention, self-care, and management of MSK health issues common in agricultural work in key agricultural health stakeholders.
2. To increase access to evidence-informed health education that emphasizes prevention, self-care, and management of common agricultural MSK health issues.
3. To increase awareness of existing MSK educational resources intended for agricultural health stakeholders.
4. To increase utilization of existing MSK educational resources intended for agricultural health stakeholders.
5. To improve the value of health education related to MSK health issues associated with agricultural work.

Evaluation of the Improvement Initiative

Formative and Summative Evaluation Methods

Below is a brief descriptive summary of PDSA cycles one through four. Data collected from each PDSA cycle was used to inform changes in the course design and delivery with the

goal of optimizing course access, awareness, and utilization. The design team helped inform each of the PDSA cycles. Although typical PDSA cycles are 90 days, the cycles in this disquisition were of varying lengths due to variables dependent on the COVID-19 pandemic and the schedules of external agencies associated with this work.

PDSA Cycle 1

The courses were made available to the general public on April 1, 2019 via a weblink. An initial email was sent out to a list of individuals and organizations involved in agricultural health at the state and national levels that was acquired through internet searches for relevant organizations and conversations with key stakeholders. This email encouraged these stakeholders to share both courses with other agriculture-affiliated groups, including MSAW. No additional communications or actions occurred to promote the courses after the initial dissemination email.

PDSA Cycle 2

Subsequent improvement PDSA cycles were carried out that were informed from data collected via formative and summative evaluations collected in the LMS and from key stakeholders involved in disseminating the courses. After reviewing the data from PDSA 1, the design team decided to reshare a version of the original email with the previous contact list along with additional newly collected contacts. Additionally, a visual digital flyer was created and shared with the email with instructions for the receiving organizations to share this digital flyer via social media on March 10, 2020.

PDSA Cycle 3

In the original implementation plan, PDSA cycle 3 and potentially cycle 4 were intended to combine the asynchronous educational materials with FtF educational sessions with both target audiences. Since FtF sessions were not possible due to mandated social distancing

associated with the COVID-19 pandemic, two alternative improvements attempts were made. For PDSA Cycle 3, this included directly engaging the NCFHP, which is considered a key stakeholder in agricultural health in North Carolina and the southeastern U.S., to assist with disseminating the asynchronous educational materials. Although the NCFHP leaders were not able to mandate the completion of the course by CHW and other HCPs affiliated with the NCFHP, they were able to post links the educational materials on their educational training webpage in November 2020.

PDSA Cycle 4

PDSA cycle 4 involved a presentation I delivered at a national farmworker conference, the 2021 Virtual Forum for Migrant and Community Health on March 25, 2021. This conference provides education and training, resource sharing, and coalition building for community centered health professionals with much of the programming focusing on MSAW health issues. Typically, this conference is delivered FtF in person, but was modified to a virtual format using the Zoom synchronous video platform due to the COVID-19 pandemic. According to Zoom room participation counts, it was estimated that between 25 and 30 individuals attended the majority of this 90-minute educational programming session. The primary learning objectives of the session were for participants to be able to:

1. Identify strategies to increase CHW and MSAW access to newly developed musculoskeletal health education resources in various hybrid delivery formats.
2. Identify primary means of accessing and distributing existing musculoskeletal health education resources for key stakeholders in agricultural worker health.
3. Recognize potential utilization and application of the hybrid health educational delivery model to the participant-specific work settings.

This disquisition utilized a mixed method research approach that included both qualitative and quantitative data collection measures in attempts to capture a more holistic assessment of the improvement initiative. Mixed methods approaches can be particularly useful by allowing the scholar practitioner to utilize qualitative data to understand context and participant perspectives, to capture feedback to refine implementation processes, and to validate quantitative data (Creswell, 2018). Evaluation of formative data in this disquisition provided a critical lens for capturing unique contextual factors both from course participants and key agricultural health stakeholders. Evaluation of summative data helped provide objective means to assessment the improvement initiative, especially after completing the implementation period.

Figure 13 below demonstrates the various formative and summative measures used to capture key indicators of change and inform subsequent changes in PDSA cycles aimed at improvement. Many of these measures were built into the LMS. Formative measures included (a) post-course formative feedback questions that were completed by course participants (see Figure 13 and Appendix C), and (b) semi-structured interviews seeking feedback from key agricultural stakeholders (see Figure 13 and Appendix D). Summative measures included assessment of learning and descriptive data related to course participant registration and completion (See Figures 13 and 17-20, and Appendix B).

Additional improvement science measures were also used to measure changes for improvement. Because a primary driver measure of this improvement initiative was related to increasing access to, awareness of, and utilization of prevention and self-care education related to MSK health for MSAW, practical measures were used to track course registration and completion rates on a monthly basis. Practical measures are rapid, relevant, and manageable data that can be utilized by practitioners to indicate how well the improvement initiative is working

throughout implementation (Langley et al., 2009). Process measures, used to monitor whether a system is performing as planned (Institute for Healthcare Improvement, 2020), were also built into the LMS. Additionally, balancing measures, which are intended to measure whether improvements in one part of a system contribute to new problems in other areas (Institute for Healthcare Improvement, 2020), were also monitored. Each of these evaluation measures and analysis of the data collected through the measures are described in greater detail below.

Figure 13

Formative and summative evaluation linked to immediate goals

Formative and Summative Data Collection Analysis				
Intended Short-term Goal(s)/Immediate Aim(s)	Data Collection Method	Data Collection Timeframe	Measurement type(s)	Data Analysis Timeframe
To improve knowledge and confidence related to prevention, self-care, and management of MSK health issues common in agricultural work in key agricultural health stakeholders	Pre/post-tests of course participants (knowledge)	End of PDSA cycles 1-4	Paired t-test	End of PDSA cycles 1-4, End of implementation
	Post-course survey Likert-scale questions (confidence)	End of PDSA cycles 1-4	Mode, mean, and frequency aggregates	End of PDSA cycles 1-4, End of implementation
	Post-course survey open-ended questions	End of PDSA cycles 1-4	In vivo and magnitude coding	End of PDSA cycles 1-4, End of implementation
To increase: …access to evidence informed MSK health education ...awareness of existing MSK educational resources intended for agricultural health stakeholders ...utilization of existing MSK educational resources intended for agricultural health stakeholders	Post-course survey Likert-scale question on likelihood of sharing course with peers	End of PDSA cycles 1-4	Mode, mean, and frequency aggregates	End of PDSA cycles 1-4, End of implementation
	Course registration and completion numbers	End of PDSA cycles 1-4	Frequency counts	End of PDSA cycles 1-4, End of implementation
	Semi-structured interviews with key agricultural health stakeholders	End of PDSA cycles 2, 3	In vivo and magnitude coding	End of PDSA cycles 2,3, End of implementation
	Educational resource utilization	End of PDSA cycles 1-4	Frequency counts	End of PDSA cycles 1-4 , End of implementation
To improve the value of health education related to MSK health issues associated with agricultural work	Post-course survey Likert-scale questions on effectiveness of course relative to other delivery methods	End of PDSA cycles 1-4	Mode, mean, and frequency aggregates	End of PDSA cycles 1-4, End of implementation
	Post-course survey question on likelihood of sharing course with peers	End of PDSA cycles 1-4	Mode, mean, and frequency aggregates	End of PDSA cycles 1-4, End of implementation

Formative and Summative Evaluation Results and Response

Before discussing the results of formative and summative data evaluation, it should be noted that the majority of data below, unless indicated otherwise, is specific to the course intended for agricultural CHWs and HCPs, farm owners, and agricultural crew leaders, as the course intended directly for MSAW did not have course registrants/participants. Even though there were no course participants for the MSAW course, the educational video content included in the course was fully accessible as a resource without formally registering for the course, and thus could be viewed by the intended audience. Data related to viewing of this resource intended for MSAW will be discussed after the data related to the course intended primarily for agricultural CHWs and HCPs.

Twenty-one participants completed the pre-course survey, pretest, educational content, and posttest. The mean participant age was 34 years old (range of 19 to 61). The highest level of formally completed education of course participants was as follows: one high school degree, one with some college without a degree, eleven Bachelor's degrees, five Master's degrees, and three Doctoral degrees.

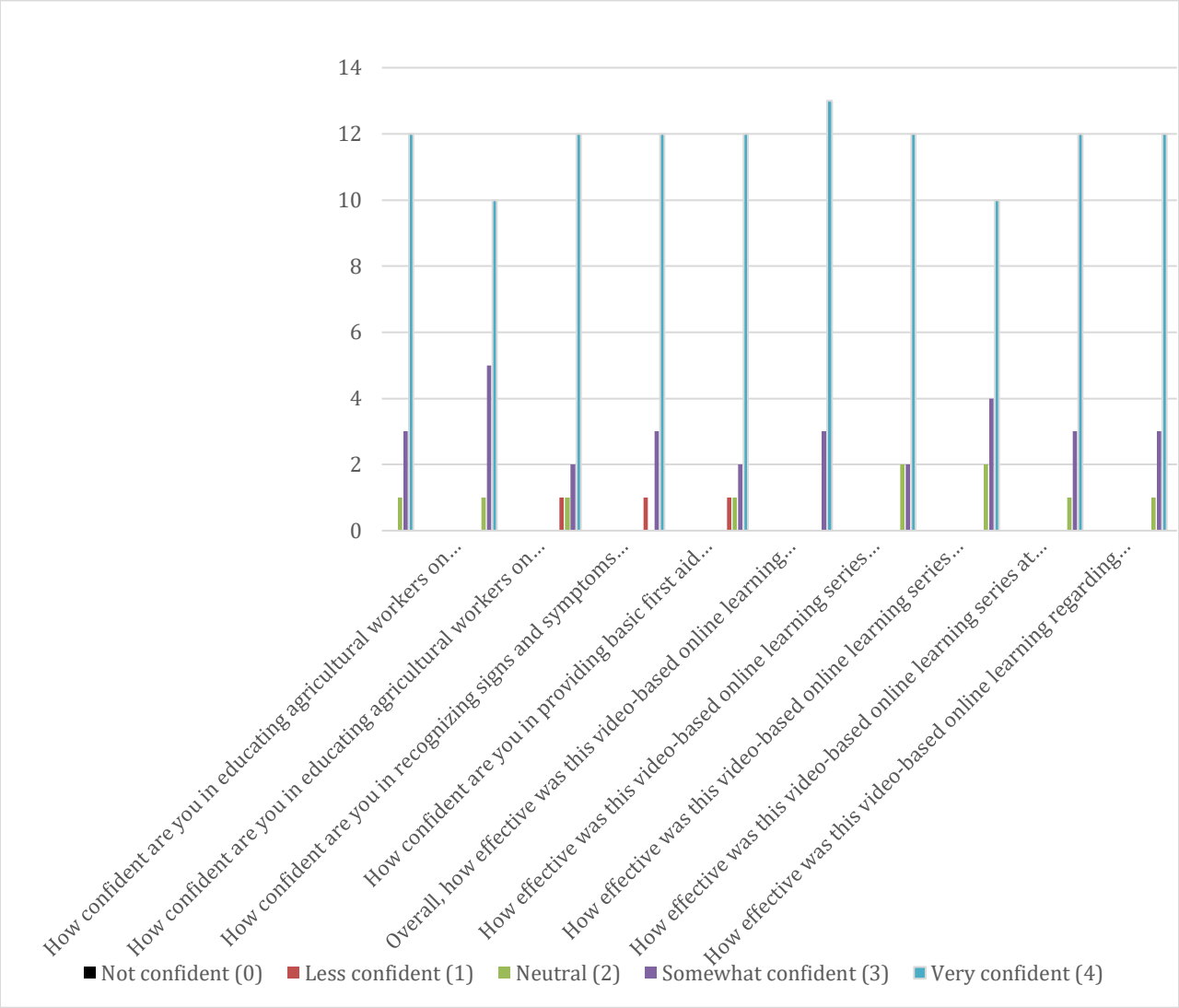
Post-course Survey Responses

After completing the online course, participants were asked to respond to ten Likert-scale questions and four open-ended questions intended to measure (a) their perceptions of their confidence levels related to knowledge and skills included in the course content (five questions) (see Figure 13, and Appendix A and B), (b) the effectiveness of the video-based online educational content and delivery format (five questions) (see Figure 13, and Appendix C), and (c) the likelihood of recommending the video-based online course (one question) (see Figure 13, and Appendix C). Since the course was delivered online, once the course was made available,

course participation was ongoing. As such, I reviewed informal data for formative purposes throughout implementation period on a monthly basis and the design team reviewed this data at the completion of each PDSA cycle. These formative evaluations indicated that participant responses were generally positive regarding their post-course confidence levels, their perceptions of the effectiveness of the course content and delivery, and the likelihood of recommending the course. The data was also evaluated summatively at the end of the entire implementation period. Summative evaluation revealed that sixteen participants completed all post-course feedback questions. For the five questions intended to measure the effectiveness of the educational materials and the delivery method, the mode response for all five questions was “very effective” with 93% of participants reporting either “very effective” or “somewhat effective” for all of these questions combined. For the five questions intended to measure confidence levels, the mode response for all five questions was “very confident” with 93% of participants reporting being either “very confident” or “somewhat confident” for all of these questions combined. Figure 14 below provides a summary of the participant post-course survey responses.

Figure 14

Summary of Participant Post-Course Survey Responses



For the four open-ended questions, formative evaluation was carried out informally by the design team at the end of each PDSA cycle, and I completed summative evaluation using coding methodology at the completion of implementation (See Figure 15). Formative evaluation indicated that the educational content and delivery methods were generally well received. The educational content appeared to be effective and appropriate, although the delivery method using the LMS appeared to be somewhat difficult to navigate for some participants. Additionally, at the

end of PDSA 3, two course participants suggested that the content could be increased in complexity and duration, and one suggested adding interactive video features to enhance learner engagement. Due to COVID, the design team did not feel that increasing the course content length or complexity was indicated at this time which will be further discussed below when considering balancing measures. The team did consider adding interactive video features to the course but were limited in making this addition to the course due to budgetary restrictions.

I completed summative evaluation solely by using coding methodology at the completion of implementation. In vivo coding was used for the first cycle of coding of participant responses. Magnitude coding was used for the second, final cycle of coding to help indicate the "intensity, frequency, direction, presence, or evaluative content" of the participant responses (Saldaña, 2016). Figure 15 below provides a summary of the qualitative coding data analysis. The coding analysis results were consistent with the formative evaluation in indicating that the educational content was generally well received, as noted below in a quote from one participant:

> I really enjoyed the video on first aid and recognizing when a farmworker needs to be evaluated further. This is a simple starting point for outreach workers that may not have medical backgrounds.

Additionally, two participants suggested that requiring strong internet connection to access the course due to the video content could be a potential barrier for some individuals.

Figure 15

Summary of the Qualitative Coding Data Analysis of Post-course Surveys

Q1 - What did you find most helpful in this learning series?	Q2 - What did you find least helpful in this learning series?	Q3 - What suggestions do you have to improve this learning series?	Q4 - What barriers could limit accessing this course?
Relevant applied video demonstrations	Difficulty navigating LMS	Easier LMS navigation	Learning platform navigation
Sufficient yet simple content	Too easy assessment of learning	Increase content length and complexity	Access to strong internet connection
Helpful screening & first aid content	N/A, everything was helpful	Add interactive video features	

Semi-structured Interviews with Key Agricultural Health Stakeholders

Semi-structured interviews were carried out with two key agricultural health stakeholders after completing PDSA cycles 2 and 3 using the Zoom platform. The health outreach coordinator for a regional farmworker health agency in western North Carolina was interviewed after PDSA 2 (Interview 1 in Figure 16), and the lead health outreach worker for the same agency was interviewed after PDSA 3 (Interview 2 in Figure 16). In vivo coding was used for the first cycle of coding and magnitude coding for the second. Although both interviews intended to capture formative feedback on the courses for both intended audiences, due to the roles and positions of the interviewees, the first (after PDSA 2) was focused more on the course intended for CHWs and the second (after PDSA 3) more on the course for MSAWs

Figure 16

Summary of the Qualitative Coding Data Analysis from Semi-structured Interviews

	Interview 1 (after PDSA 2)	Interview 2 (after PDSA 3)
Q1 – Benefits of asynchronous online educational courses for your organization?	• For CHW: • Time-efficient • Permits learner flexibility • Best for basic health education	• For MSAW: • Allows flexible learning times • Adaptable with subtitles • Self-paced learning
Q2 -Barriers/challenges of asynchronous online educational courses for your organization?	• Suboptimal for complex and "hands on" topics • Zoom/non-FtF fatigue due to COVID • Importance of human interaction • May not always be contextually specific	• Suboptimal for learners with specific issues/questions • Difficulty scaling to individual learning levels
Q3 - Ideal use/ratio of hybrid asynchronous and synchronous learning?	• Basics best asynchronous • Hybrid asynchronous/synchronous is optimal • Positive recent experience with video-based asynchronous	• More asynchronous better for MSAW • More FtF better for CHW
Q4 - Additional thoughts on use of Information & Communication Technology?	• Strong potential with ubiquitous smartphones • Must be aware of barriers for MSAW (internet signal and strength, login/email/passwords, etc.)	• Strong potential • Allows private viewing for sensitive topics • Positive recent experience with asynchronous videos using personal story
Q5 - Best type(s) of technology?	• WhatsApp and WhatsApp Story • Tablets with hotspots and Zoom	• WhatsApp and WhatsApp Story
Q6 - Additional thoughts on the topic?	• Remove barriers (see Q4) • Basic surveys (e.g., Google forms) are alternative to LMS for MSAW • Have CHW facilitate access to LMS during FtF visits	• Short video clips with less barriers to access better for MSAW

Data analysis from Interview 1 provided valuable information related to the course intended for agricultural CHWs and HCPs, farm owners, and agricultural crew leaders. The interview feedback was consistent with the proposed benefits of asynchronous online learning for this intended audience of being time-efficient, providing learners with flexibility in how and when they learn, and being most appropriate for “basic” foundational health education, also

referred earlier to as generalizable education. The following interview quote highlights these benefits:

> Asynchronous educational resources definitely help the outreach workers a lot because they are frequently on the go and can use their time more efficiently to watch videos and use time efficiently to learn, have time to grasp the information, and then disseminate the education to farmworkers at the appropriate times. Every group and every farm are unique as work tasks are differently across different regions based on crops, farm type, work demands. It's important to have foundational information that applies to all agricultural work, but also be able to individualize it to meet farm-specific demands.

Consistent with the literature, the interviewee noted that some content may be best combined with FtF educational sessions in a hybrid manner, especially "hands-on" topics and contextually specific application of the foundational knowledge. Interestingly, the interviewee also noted feeling considerable "Zoom fatigue" because most of the daily work and non-work activities involving human interaction had transitioned from in-person to remote via Zoom during the pandemic, including educational trainings. These sentiments are noted in the following quote:

> I think having a mixture (of learning mediums) is really important. With COVID we have all been going crazy with everything moved to Zoom. There are so many Zoom meetings and webinars about COVID. Not being able to be in groups together, learning from each other, talking in focus groups or brainstorming has been tough, as Zoom breakout rooms can be limiting. We all need some level of human interaction when it comes to education.

Based on this formative data, the design team would have recommended adding a component of in-person FtF training with this population, which was consistent with the original implementation plan. However, the COVID-19 pandemic persisted at the end of PDSA 2 and

throughout the entire implementation period of this initiative. Therefore, the team recommended continuing efforts to disseminate the educational courses via other means. The NCFHP indicated that they could add links to the courses on their main educational training webpage with the goal of increasing access to, awareness of, and utilization of the educational courses and resources.

Data analysis from Interview 2 provided valuable information related to increasing access to the educational materials intended for MSAW. The interviewee noted that typically CHWs visit farmworker living quarters in the evening hours after large groups of farmworkers return from long days working in the fields, which frequently limits time to provide individualized FtF education. Because of this, the interviewee suggested that asynchronous video-based educational delivery formats were ideal for MSAW, as noted in this quote:

> For farmworkers, the ideal ratio might be something like 25% synchronous face-to-face and 75% asynchronous because when they arrive home late in the day being very tired, connecting face-to-face is difficult because they are busy preparing for the next day. But for outreach workers, these percentages could be flipped to have more synchronous face-to-face than asynchronous.

Also consistent with data collected in interview 1, it was noted that asynchronous education may not always meet the needs of all MSAW, especially regarding issues that are more individualized and contextually specific.

Data from both interviews suggested strong potential for hybridizing the delivery of health education for MSAW when considering the ubiquity of cell phone use. However, to be successful, certain barriers needed to be reduced. This included ensuring having internet signal with adequate strength, and when possible, eliminating/reducing requirements such as logins, email addresses, and passwords to access the educational information. Thus, the design team

recommended continued efforts to disseminate the course intended for CHWs, but to encourage sharing only the internet link of the educational resource video intended for MSAW alone rather than encouraging MSAW to complete the course using the LMS. Both interviewees identified WhatsApp and WhatsApp Story as excellent mediums to share these video links with MSAW. This information informed the fourth and final PDSA cycle which involved sharing the educational course intended for CHWs and the educational resource intended for MSAW at a national conference attended primarily by agricultural health workers.

Additional Improvement Science Measures: Practical, Process, and Balancing Measures

Practical Measures

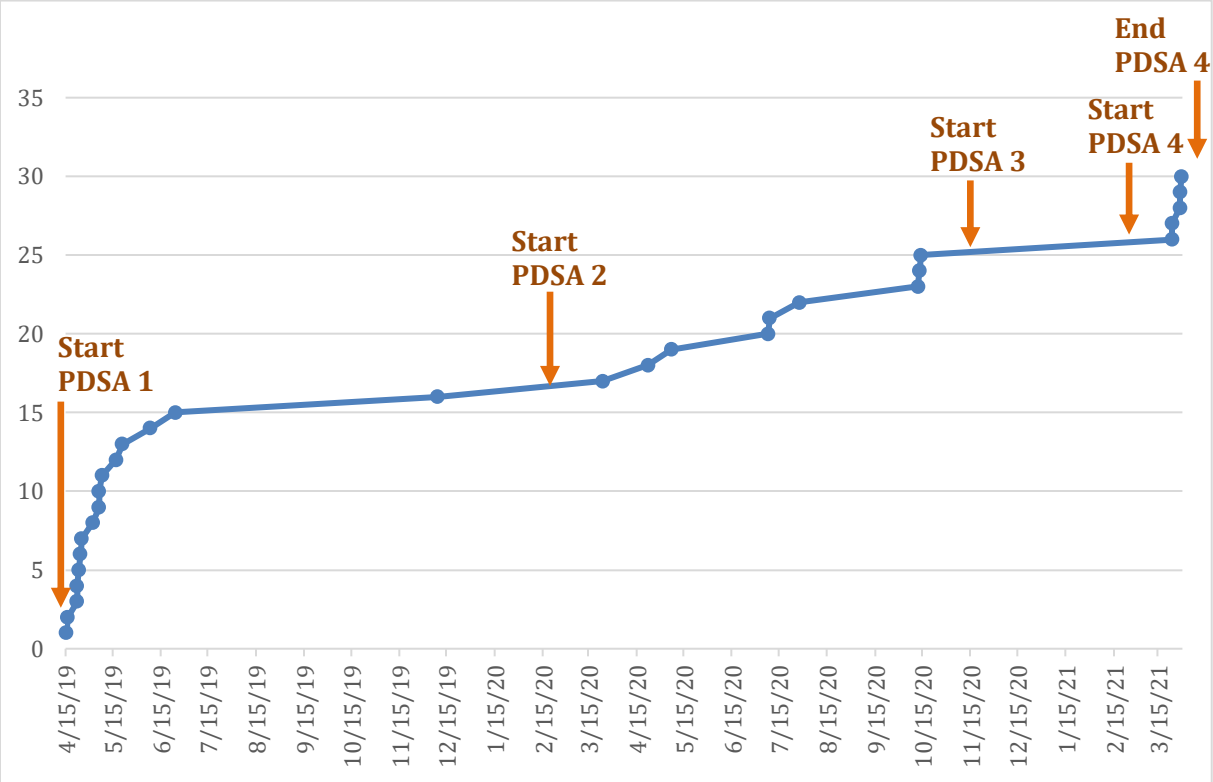
Practical measures were used to track course registration and completion rates on a monthly basis, at the end of each PDSA cycle, and at the completion of the implementation period. Because practical measures by definition are rapid and easy, accessing course registration and completion rates in the LMS was a quick, easy, and feasible means of assessing how well the implementation plan was being carried out specifically related to immediate goals two through four of increasing access to, awareness of, and utilization of this education. Using the LMS, it was also quick, easy, and feasible to assess the immediate goal related to increasing knowledge and confidence in the educational content area by viewing course participant pretest and posttest scores. Each of these noted practical measures was also evaluated summatively at the end of the implementation period which is described in greater detail below.

Course registration rates started out strong at the beginning of PDSA 1 after an email was shared with numerous regional and national agricultural health agencies as noted below in Figure 17. Eleven participants registered within the first 30 days and fourteen participants registered within the first 60 days. After this strong initial registration, there was a substantial period where

minimal course registration occurred, with only two registrants over the next 240 days when PDSA 1 ended and PDSA 2 began. The noted pattern of a strong initial interest in the course after a strategic effort occurred to communicate the availability of the course with key stakeholders, followed by a sharp decrease in interest when no additional communication about the course occurred was not surprising to the design team, and reinforced the importance of regular communication with intended course audiences and key stakeholders.

Figure 17

Course Participant Registration Rates



PDSA 2 cycle also started off strong after sending an additional email along with adding a component of social media sharing of the course. Three participants registered within the first 45 days and another three within 120 days of the cycle. Interestingly, PDSA 2 was initiated around the time of the peak onset of the COVID-19 pandemic in March of 2020. This may have

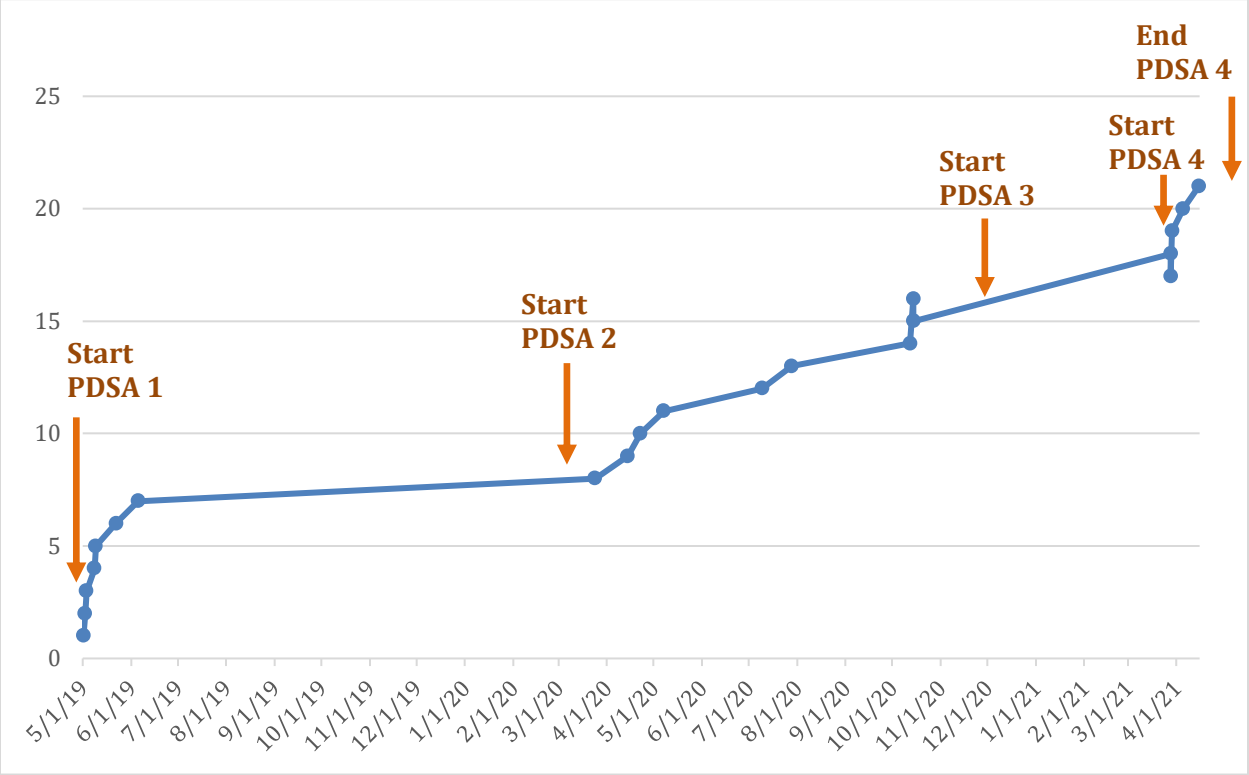
explained why there were fewer initial registrants when compared to the start of PDSA 1. PDSA 3 resulted in no increased course participation. The design team interpreted this lack of improvement to a significantly smaller audience being reached by the change idea of adding the course links to the NCFHP webpage, and to the lack of mandating and/or encouraging course participation by the NCFHP leaders due to prioritizing health education related to COVID-19. Finally, PDSA 4 began with five course registrants within the first 7 days.

Process Measures

Many of the same practical measures noted above were also utilized as process measures, which are used to monitor whether a system is performing as planned (Institute for Healthcare Improvement, 2021). However, an additional component of monitoring the percentage of individuals who registered for the course who went on to complete it was added as a process measure. After starting PDSA 1, 64%, or seven of the eleven participants who registered for the course during the first 30 days also completed the course during this same time period as noted in Figure 18. The design team deemed this completion rate to be acceptable after hypothesizing that some registrants may have primarily been interested in viewing the educational resources and delivery methods out of curiosity of the potential utility of sharing the course with their respective organizations. Data from subsequent PDSA cycles supported this hypothesis as completion rates greatly improved to 100% during both PDSA 2 (nine of nine completions) and PDSA 4 (five of five completions).

Figure 18

Course Participant Completion Rates



When considering factors that influenced course registration and completions rates, it is important to acknowledge that both agricultural work and work associated with agricultural health follow regular annual seasonal schedules. For instance, in western North Carolina, seasonal agricultural work increases substantially during the growing season towards the end of spring and the beginning of summer, and then decreases in the early fall towards the end of the growing season of crops commonly grown in this region, such as tomatoes, peppers, and strawberries. CHWs work diligently during the growing season to provide MSAW with health education and help facilitate access to healthcare when indicated. Thus, the optimal time period for providing health education to MSAW would be just prior to or early during the growing season in late spring. Conversely, the optimal period for providing health education for CHW

and HCPs who serve agricultural workers would be during the non-growing season, especially during late winter and early spring. Because of this optimal period of training for CHWs and HCPs, three of the four PDSA cycles were initiated during early spring. Figures 17 and 18 show that both course registration and course completion rates were highest shortly after the initiation of these three spring cycles. Thus, both the changes ideas in these PDSA cycles and promoting the courses during the optimal seasonal period for training may have influenced the increase in course participation.

Balancing measures

Balancing measures were used during the implementation period to help ensure that changes intended to improve one part of the system did not contribute to new problems in other parts of this system. This was accomplished by carrying out informal verbal inquiries with key organizational stakeholders associated with Vecinos and the NCFHP after the initiation of PDSA 2 and PDSA 3 to capture whether participation in either of the courses may have resulted in any unintended disruption to standard work practices and/or educational training in other important areas. Course participants required approximately 45-60 minutes to complete the course intended for CHWs, HCPs, farm owners, and agricultural crew leaders, and approximately 25-30 minutes to complete the course intended for MSAW. The inquiries with key stakeholders revealed that after the onset of the COVID-19 pandemic beginning in March 2020, educational programing and trainings for both the agricultural health and MSAW communities had drastically shifted away from their typical programming towards COVID-19 trainings. Thus, educational trainings related to musculoskeletal health in agriculture and other non-COVID-19 topics were greatly deemphasized from March 2020 through the completion of the implementation period of this initiative in June 2021, which corresponded with PDSA cycles 2 through 4. However, when

considering the relatively short duration of both courses, the design team did not feel shortening the course lengths was indicated.

Outcome Measures

In improvement science, outcome measures help provide baseline data related to a noted problem and also help evaluate improvement related to the primary aims of the initiative. For this initiative, summative outcome measures included assessment of learning using pretest and posttests completed by course participants, and descriptive data related to course registration, course completion, and utilization of educational resources, all of which were related to the previously noted immediate aims of this initiative.

Pre and Post Test Scores

An important immediate goal of this improvement initiative was to improve knowledge and confidence related to prevention, self-care, and management of MSK health issues common in agricultural work in key agricultural health stakeholders. To measure the effectiveness of the course in meeting the knowledge component of this goal, repeated measures testing was used by having course participants complete a ten-question assessment prior to completing the course (pretest) followed by the same assessment after completing the course (posttest). Both assessments were built into the LMS. A paired *t* test analysis was used to determine statistical significance between pretest and posttest scores of all course participants. It was hypothesized that there would be a significant difference between pretest and posttest scores, with the null hypothesis being that there would be no difference. SPSS for was used for data analysis. Twenty-one participants completed all aspects of the pretest and the posttest. The mean difference between pretest and posttest scores for all participants was 1.429 with *t* value of 4.939, and a p-value of 0.000 as shown below in Figure 19. Thus, the null hypothesis that there was no

difference between scores was rejected in favor of the alternative hypothesis that there was a difference between pretest and posttest scores.

Figure 19

Paired Samples Test of Pretest and Posttest Knowledge Changes

	Mean	Standard Deviation	Standard Error Mean	t	df	Significance (2-tailed)
Pretest – Posttest	1.429	1.326	.289	4.939	20	.000

Course Registration and Completion Rates

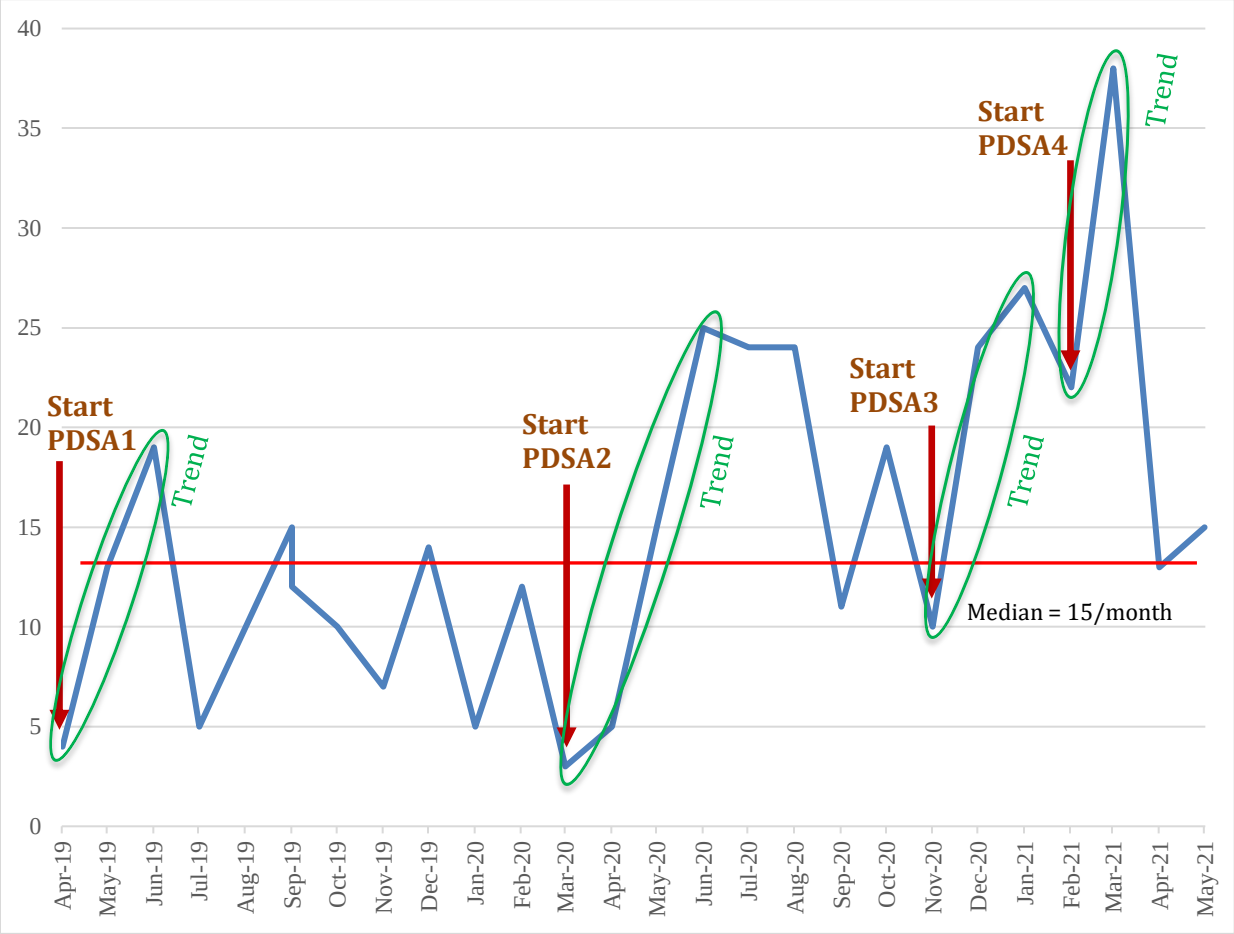
Figures 17 and 18 used above to describe formative evaluation of course participant registration and completion rates throughout the implementation period were also used for summative evaluation. A total of thirty individuals registered for the course with twenty-one of the thirty (70%) completing the course pretest, viewing all educational videos, and completing the posttest. As noted in the introduction to the local problem of practice associated with this disquisition, accurate and meaningful estimates of individuals in the agricultural health community who receive educational training related to musculoskeletal health in agricultural work were not available. However, data collected in the pre-course survey indicated that only three of the twenty-one participants (14%) who completed the course reported having received educational training in this specific area within the past five years. This suggests that a low percentage of agricultural health workers receiving training in this area. Data from this initiative related to the number of individuals who received this training may serve as a useful baseline measure for future educational trainings on the topic.

Utilization Rates of Educational Resources intended for MSAW

As noted previously, no participants completed the online course intended for MSAW. Potential explanations for this lack of participation based on the semi-structured interviews with key agricultural stakeholders discussed above include barriers such as requiring strong internet access, along with requiring login information consisting of participant name, a valid email address, and a specific password. However, the educational video included in the course was fully accessible as a resource for non-registered "guests" on the main webpage that hosted the courses, and could also be accessed via a URL link. Thus, data tracking the number of guest views of this educational resource was available in the LMS. Figure 20 below is a run chart that highlights the number of individual views of the educational video over the full implementation period.

Figure 20

Number of Views of the Video-based Educational Resource Intended for MSAW



Run charts can be used as a valuable analytical tool for quality improvement and learning about the performance of processes with minimal mathematical complexity. An advantage of analyzing data with run charts is that they preserve the original time order of data, and thus can help indicate whether a change in a system is associated with a sustainable improvement where the change occurred. Probability-based rules, referred to as shifts, trends, and runs, can be used to objectively analyze run-chart data to identify evidence of non-random patterns based on an alpha error of $p<0.05$ (Rocco et al., 2011). The median number of guest views per month was 15.03 over the entire implementation period, which is indicated in Figure 20 as the centerline, or

the point at which half of the video views are both above and below the line. Positive trends, defined as five or more consecutive points all going up on a run chart (Rocco et al., 2011), can be seen in the figure after the start of each of the PDSA cycles where a change idea was implemented. Additionally, positive shifts, defined as six or more consecutive points all above the median (Rocco et al., 2011), can also be seen after each of the four PDSA cycles. This data provides evidence that these noted improvements in viewing of the educational videos after each of the PDSA cycles when a change idea was implemented were non-random patterns. Each positive trend in PDSA 1 through 4 is immediately followed by a negative trend within approximately 60-90 days after the start of each cycle, with negative shifts also present after PDSA 1, 2, and 4. This data suggests that although each of the change idea appears to be associated with improvement shortly after implementing, these improvements were not sustained.

Measuring Value

As noted previously, value in healthcare was originally defined by Porter and Teisberg (2006) simply as health outcome per cost. More recently additional aspects such as quality, service, access to care, patient centeredness, and guideline concordant and integrated care have been added to health outcomes and cost effectiveness in defining value in healthcare (Cook et al., 2021; Pendleton, 2018). It was not within the feasible scope of this disquisition to measure the ultimate aim related to value by improving farmworker musculoskeletal health outcomes at lower cost. However, it was possible to measure various indicators of improvement related to one of the aims of improving the value of health education related to MSK health issues associated with agricultural work. These measures are noted above in Figure 13 and are discussed further below.

Post-course survey Likert-scale questions were used as indicators of perceived value. The questions included asking participants to rate (a) the effectiveness of course relative to other delivery methods, and (b) the likelihood of sharing the course with peers. These questions included comparing the effectiveness of the video-based courses to previous job training during the past year that were delivered in (a) written form only and (b) face-to-face only. As noted above in Figure 14, 93% of participants rated the course content and delivery as "very effective" or "somewhat effective" for all questions combined related to course effectiveness. Additionally, 90% of course participants rated that they were either "likely" or "very likely" to recommend the course to another healthcare provider or colleague. These responses are indicators of positive perceived value in that participants generally reported the educational content and delivery as effective with all participants rating it equal or superior to more traditional modes of educational design and delivery.

Results Summary

The following is a summary of the results of this improvement initiative:

- 93% of participants responded either "very effective" or "somewhat effective" for all post-course survey questions combined regarding the effectiveness of the educational materials and the delivery method.
- 93% of participants reported being either "very confident" or "somewhat confident" for all post-course survey questions combined intended to measure confidence levels.
- Post-course qualitative responses indicated the educational content was generally well received, although requiring strong internet connection was a noted potential barrier to access.

- Semi-structured interviews with key agricultural health stakeholders supported evidence in the literature and the hypothesized theory of improvement related to the benefits and limitations of asynchronous and hybridized online learning. Benefits included being time-efficient, providing learners with flexibility, and being most appropriate for basic-level health education. Limitations included not always meeting the individualized and contextually specific needs of the intended audience.
- Pre and post test scores supported meeting the goal of improving course participant knowledge and confidence related to prevention, self-care, and management of common MSK health issues.
- Each of the change ideas introduced to increase course registration and completion rates and educational resource utilization rates appeared to be associated with short-term improvements.
- Post-course survey Likert-scale questions used as indicators of perceived value were generally positive with all participants rating the educational delivery as equal or superior to more traditional modes of delivery.

Recommendations for Continuing the Work

The formative and summative evaluation summary of this improvement initiative noted above demonstrate a number of positive indicators of improvement intended to address each of the immediate aims of the initiative. Specific to summative evaluation, improvements were noted in knowledge and confidence related to prevention, self-care, and management of MSK health issues common in agricultural work for key agricultural health stakeholders who completed the educational training. Positive indicators were also noted related to the goals seeking to increase access to, awareness of, and utilization of evidence informed health education for common

agricultural MSK health issues. Last, for the goal seeking to improve the value of health education related to MSK health issues associated with agricultural work, analysis revealed positive indicators of perceived value by course participants related to the educational content and asynchronous online delivery. Although the summative evaluation provided meaningful information for assessing the outcomes and impact of the initiative, a number of valuable leadership lessons can also be taken to help guide future improvement efforts related to this initiative and others in similar fields which are discussed below.

Leadership Lessons Learned

Focus initial efforts on a specific targeted group.

This disquisition improvement initiative intended to increase access to educational trainings for two distinct audiences, (a) MSAW, and (b) key stakeholders associated with agricultural health. This second noted group consisted of various subgroups that included CHWs, HCPs, farm owners, and agricultural crew leaders. Potential benefits exist when implementing change ideas that seek to influence multiple aspects of a complex system, including having a larger impact across the system. Successful efforts require strong intra and inter organizational collaboration, multi-level organizational expertise and "buy in", and leadership at the systems and "day-to-day" levels (Institute for Healthcare Improvement, 2021). However, for this initiative, choosing to focus on only one of the target audiences at a time may have allowed greater attention to what was working and what was not, and consequently facilitated more nimble changes by the design team throughout implementation.

Related, the content in the course intended for agricultural health stakeholders was developed at the foundational educational level primarily for CHWs who commonly have limited formal medical training. Based on post-survey responses, it appeared the course content was

established at the appropriate level for CHWs, but may have been too basic for other audiences with more medical training or more experience in agricultural health based on two participant responses in the post-course surveys. Considering that eight of the twenty-one participants had completed Master's or Doctoral degrees, and another eleven had completed Bachelor's degrees, providing more advanced educational trainings options for those with higher level learning needs may be indicated in the future.

Add contextually-specific supplemental education in a hybridized manner as indicated.

Because the course content was intended to be generalizable, supplemental education tailored more towards contextually specific occupational environments may also be needed. Supported both in the literature and in the semi-structured interviews above, delivering more contextually specific educational training may be best addressed by pairing asynchronous learning with synchronous FtF learning opportunities where foundational knowledge can be contextually applied. Optimal ratios of combined asynchronous and synchronous educational delivery are not known at this time, and likely vary depending on a number of contextually dependent factors. Identifying optimal ratios of asynchronous and synchronous educational delivery related to this work and others in similar areas is a rich topic for future research and improvement efforts.

Challenges associated with varying levels of insider/outsider positionality.

An anticipated challenge that surfaced in this disquisition was that in most scholar practitioner improvement initiatives, the scholar practitioner is considered both an outsider studying an issue from "afar" and also a strong insider seeking improvement directly related to their immediate work. For this disquisition, my position was substantially stronger as an outsider than an insider, as my primary domain of work is in the realm of doctor of physical therapy

education rather than agricultural health. Thus, my capacity to influence and modify systems related to educational practices in the agriculture and agricultural health sectors felt limited at times. Establishing stronger relational trust with organizations affiliated with farm owners and agricultural crew leaders may have improved course participation in these groups and also in the farmworkers they serve.

Transformative value enhancement requires large scale organizational collaboration.

Related, seeking to address the first noted problem of practice of improving value in healthcare through a better health education model was grand in that it sought to address an issue in healthcare that many would refer to as a "wicked problem". Such problems commonly have numerous causes and contributing factors, are challenging to describe, and rarely have "right" answers or perfect solutions (Camillus, 2008). Although meaningful information was gained throughout this improvement initiative, truly transformative efforts will require large-scale organizational collaboration across numerous public and private sectors. It is in such collaboration where true value would likely surface via large-scale dissemination strategies of evidence-informed, highly accessible eLearning health education delivered in a semi-standardized manner. Costs would be shared broadly across multiple agencies, and eLearning analytics could be used to track learning and health outcomes and inform iterative improvement efforts.

Anticipate unintended consequences and minimize barriers to access.

Numerous lessons were also learned in seeking to disseminate the educational content intended for MSAW. Although a primary goal of the aim was to increase access to this education for MSAW, an unintended consequence/barrier to access was added by using an LMS which required registration with a valid email address and a password. This barrier occurred because

the design team had hoped to better track participant learning outcomes and engagement analytics directly in the LMS with this population. Additionally, MSAWs needed to have sufficient digital literacy to navigate the online learning platform, which was a challenge noted by two participants in the course intended for CHW. These lessons are consistent with warnings provided by Yee et al. (2018) who noted that although improving the delivery of health education using ICT has the potential to be particularly beneficial for populations with greater health disparities, ICT could also the potentially widen the disparity gap for vulnerable populations if key components are not considered. This is a valuable lesson for leaders of equity and justice initiatives to thoroughly consider unintended consequences that could hinder well-intentioned efforts.

In the future, it would be advisable to remove any unnecessary barriers for MSAW when possible. For example, direct access to the educational videos could be provided for MSAW using URL links shared via a social media app such as WhatsApp, as suggested in the semi-structured interviews above. Minimally cumbersome data collection methods could be used for measuring intended outcomes and for learning for improvement instead of more cumbersome LMS collection methods. Alternatively farm owners, crew leaders, and/or CHWs could facilitate group access to the learning materials in the LMS for MSAW during FtF sessions.

Internet access is still an issue in rural areas.

A challenge that was anticipated at the outset of the initiative was not only having access to internet service but also sufficiently strong internet signals to permit viewing video content. Based on the semi-structured interviews, this was more of an issue for MSAW than for other key agricultural health stakeholders. Information gained from these interviews also revealed successful recent experiences to mitigate weak internet signals by using Hotspots to boost signal

strength and using other forms of digital ICT to disseminate education to MSAW, including tablet computers with Zoom capabilities and playing educational videos on large monitors during outreach visits to farmworker group living quarters. When considering that many MSAW have highly limited access to healthcare and health education resources, enhancing efforts to disseminate health education using ICT may be one of a limited number of feasible options for addressing health disparities in this population.

Conclusion

This disquisition aimed to gain valuable information related to improving the health education component of healthcare. Implications of the initiative in the global context include the potential to improve the value of healthcare through more effective health education, better health outcomes, better perceptions of care, and lower costs. Implications in the context of MSAW MSK health include the potential to improve (a) knowledge and confidence related to prevention and self-care of common MSK health conditions in agriculture for key agricultural health stakeholders, (b) access to evidence-informed health education that emphasizes prevention and self-care related to MSK health issues associated with agricultural work, and (c) the value of health education in this area. Although a number of factors contribute to the noted issues in both the global and local contexts of this improvement initiative, the results suggest that integrating asynchronous eLearning in various combinations with synchronous FtF learning in a hybridized manner has the potential to improve access to health education, health outcomes, and value associated with the health education component of healthcare. In our commitment to addressing health inequities in some of the most vulnerable populations, we must continue to explore creative, practical, and cost-effective ways to improve access to essential health education. Using ICT to help address these inequities has promising potential, although we must be particularly

sensitive of potential unintended consequences to ensure that the use technology alleviates rather than exacerbates essential issues of justice and health equity.

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Appendix A

Musculoskeletal Learning Series Pre-course Survey

-Age

_____

-Gender

O Male (1)

O Female (2)

O Other (3)

-Highest level of education completed

O Elementary (1)

O Some high school (2)

O Graduated high school (3)

O Some college, no degree (4)

O Associate's degree (5)

O Bachelor's degree (6)

O Master's degree (7)

O Professional degree (8)

O Doctorate degree (9)

-Field of work:

- Health outreach worker
- Farm owners
- Crew leader
- Farmworker
- Other: _____

-Years of experience working in agriculture

Appendix B

Musculoskeletal Learning Series Pretest and Posttest

Which of the following is NOT considered a barrier to accessing care for agricultural workers?

O High healthcare costs (1)

O Age (2)

O Decreased literacy rates (3)

O Limited transportation (4)

Which of the following is NOT considered a risk factor for developing musculoskeletal symptoms in agricultural workers?

O Long work hours (1)

O Repetitive movements and work tasks throughout the day (2)

O Frequent recovery breaks (3)

O Emotional stress (4)

All of the following are considered protective/preventive factors that can help reduce the risk of developing musculoskeletal symptoms EXCEPT...

O Healthy weight (1)

O Repetitive movement (2)

O Adequate sleep (3)

O Good fitness level with regular exercise (4)

All of the following techniques are recommended when lifting and lowering heavy objects EXCEPT...

O Standing close to the object with the feet shoulder width apart (1)

O Bending at the hips and knees while keeping a straight back (2)

O Bending over the object and lifting with the back (3)

O Lifting with the legs and engaging the abdominal muscles (4)

Which of the following is helpful in limiting susceptible prolonged postures and repetitive movements?

O Rotating the body in one direction only to avoid injuring the opposite side (1)

O Keeping the back, hips, and knees bent for extended periods of time (2)

O Always carrying heavy loads on the stronger side of the body (3)

O Keeping a slight bend in the knees when standing for long periods of time (4)

An agricultural worker is experiencing severe lower back pain as well as numbness, tingling, and weakness in the left leg down to the foot. What advice would you give the worker?

O Stretch every morning before work (1)

O Try prescription pain medications (2)

O Refer the worker to a licensed health care provider (3)

O Inform the worker that these symptoms are typical and usually go away after a few days or weeks (4)

Ice may be an appropriate strategy in the early stages of minor musculoskeletal discomfort or swelling. Approximately how long should the ice pack be left on the body tissue during one application?

O No more than 5 minutes (1)

O Up to 20 minutes (2)

O At least 1 hour (3)

O The ice pack can stay on all day, and only be taken off to replenish the ice itself (4)

All of the following are considered red flag symptoms EXCEPT:

O Radiating numbness, tingling, or pain down the arms/legs (1)

O Muscle soreness after strenuous work (2)

O Unexplained weight loss (3)

O Difficulty urinating (4)

All of the following are protective factors that can be implemented during the workday EXCEPT:

O Varying work tasks throughout the day

O Alternating use of both sides of body

O Taking one long break during the day instead of multiple short ones

O Taking time to stretch during tasks requiring prolonged postures

Which of the following is NOT considered a normal response to physical stress and physical activity associated with strenuous work

O Soreness should lessen as the body adapts to the task demands

O Increased initial soreness after returning to strenuous work after taking long periods off

O Persistent and severe pain in the evening that interferes with sleep

O Adaptation of muscles and body tissues to the loads placed on the body

Select the most appropriate response:

	Very unconfident (1)	Somewhat unconfident (2)	Neutral (3)	Somewhat confident (4)	Very confident (5)
How confident are you in recognizing risk factors for musculoskeletal symptoms? (1)	O	O	O	O	O
How confident are you in educating agricultural workers on heavy lifting and movement strategies? (2)	O	O	O	O	O
How confident are you in educating agricultural workers on protective factors that can help reduce the likelihood of developing musculoskeletal symptoms? (3)	O	O	O	O	O
How confident are you in recognizing signs and symptoms suggesting a worker should be referred to a licensed healthcare provider? (4)	O	O	O	O	O
How confident are you in providing basic first aid recommendations for basic musculoskeletal health conditions? (5)	O	O	O	O	O

Musculoskeletal Learning Series Posttest

Which of the following is NOT considered a barrier to accessing care for agricultural workers?

- High healthcare costs (1)
- **Age (2)**
- Decreased literacy rates (3)
- Limited transportation (4)

Which of the following is NOT considered a risk factor for developing musculoskeletal symptoms in agricultural workers?

- Long work hours (1)
- Repetitive movements and work tasks throughout the day (2)
- **Frequent recovery breaks (3)**
- Emotional stress (4)

All of the following are considered protective/preventive factors that can help reduce the risk of developing musculoskeletal symptoms EXCEPT...

- Healthy weight (1)
- **Repetitive movement (2)**
- Adequate sleep (3)
- Good fitness level with regular exercise (4)

All of the following techniques are recommended when lifting and lowering heavy objects EXCEPT...

- Standing close to the object with the feet shoulder width apart (1)
- Bending at the hips and knees while keeping a straight back (2)
- **Bending over the object and lifting with the back (3)**
- Lifting with the legs and engaging the abdominal muscles (4)

Which of the following is helpful in limiting susceptible prolonged postures and repetitive movements?

- Rotating the body in one direction only to avoid injuring the opposite side (1)
- Keeping the back, hips, and knees bent for extended periods of time (2)
- Always carrying heavy loads on the stronger side of the body (3)
- **Keeping a slight bend in the knees when standing for long periods of time (4)**

An agricultural worker is experiencing severe lower back pain as well as numbness, tingling, and weakness in the left leg down to the foot. What advice would you give the worker?

- Stretch every morning before work (1)
- Try prescription pain medications (2)
- **Refer the worker to a licensed health care provider (3)**
- Inform the worker that these symptoms are typical and usually go away after a few days or weeks (4)

Ice is an appropriate strategy in the early stages of minor musculoskeletal discomfort or swelling. Approximately how long should the ice pack be left on the body tissue during one application?

- No more than 5 minutes (1)
- **Up to 20 minutes (2)**
- At least 1 hour (3)
- The ice pack can stay on all day, and only be taken off to replenish the ice itself (4)

All of the following are considered red flag symptoms EXCEPT:

- Radiating numbness, tingling, or pain down the arms/legs (1)
- **Muscle soreness after strenuous work (2)**
- Unexplained weight loss (3)
- Difficulty urinating (4)

All of the following are protective factors that can be implemented during the work day EXCEPT:

- Varying work tasks throughout the day (1)
- Alternating use of both sides of the body with work (2)
- **Taking one long break during the day instead of multiple shorter ones (3)**
- Taking time to stretch during tasks requiring prolonged postures (4)

Which of the following is NOT considered a normal response to physical stress and physical activity associated with strenuous work

- Soreness should lessen as the body adapts to the task demands
- Increased initial soreness after returning to strenuous work after taking long periods off
- **Persistent and severe pain in the evening that interferes with sleep**
- Adaptation of muscles and body tissues to the loads placed on the body

Select the most appropriate response:

	Not at all confident (1)	Less confident (2)	Neutral (3)	Somewhat confident (4)	Very confident (5)
How confident are you in recognizing risk factors for musculoskeletal symptoms? (1)	○	○	○	○	○
How confident are you in educating agricultural workers on proper lifting and bending movement strategies? (2)	○	○	○	○	○
How confident are you in educating agricultural workers on protective/preventive factors that can help reduce the likelihood of developing musculoskeletal symptoms? (3)	○	○	○	○	○
How confident are you in recognizing signs and symptoms suggesting a worker should be referred to a licensed healthcare provider? (4)	○	○	○	○	○
How confident are you in providing basic first aid recommendations for basic musculoskeletal health conditions? (5)	○	○	○	○	○

Appendix C

Musculoskeletal Learning Series Post Course Survey

Select the most appropriate response:	Not at all effective (1)	Less effective (2)	Neutral/No preference (3)	Somewhat more effective (4)	Very effective (5)
Overall, how effective was this video-based online learning series? (1)	○	○	○	○	○
How effective was this video-based online learning series compared to written/textbook ones you may have previously completed? (2)	○	○	○	○	○
How effective was this video-based online learning series compared to face-to-face learning you may have completed in the past? (3)	○	○	○	○	○
How effective was video-based online learning series at demonstrating techniques involving movement tasks (such as bending/lifting instructions) compared to traditional learning delivery models? (4)	○	○	○	○	○
How effective was this video-based online learning regarding the ease of accessing the learning materials compared to traditional learning delivery models? (5) How relevant is this course material towards your work? (6) How likely are you to share this information to your peers? (7) How likely are you to recommend this course to your peers? (8)	○	○	○	○	○

What did you find most helpful in this learning series?

What did you find least helpful in this learning series?

What suggestions do you have to improve this learning series?

Which of the following, if any, were barriers to accessing this course?
(Mixed response, select all that apply?)

- Access to an electronic device (smartphone, computer, etc.)
- Access to internet
- Having a strong enough internet connection
- Difficulty using the learning platform used to take the course
- Other _____

Appendix D

Additional Formative Feedback Questions from Key Stakeholder

The following questions were used to collect data from key stakeholders involved in agricultural health associated with Vecinos Farmworker Health Program and the North Carolina Farmworker Health Program. These agencies represent important stakeholder perspectives on health issues associated with agricultural work at the local, state (North Carolina) and national (United States) levels.

Semi-structured Interview Questions

1. Describe the benefits associated with the asynchronous online educational courses in meeting the needs of your organization?
2. Describe the barriers/challenges associated with the asynchronous online educational courses in meeting the needs of your organization?
3. Describe your perceptions of how the potential hybrid delivery of asynchronous educational content (e.g., online courses and/or prerecorded learning materials such as videos) and synchronous (either Face-to-Face or remote e.g., webinar or Zoom meeting) could be used to enhance or hinder health education for your organization?
4. What are your thoughts on how Information and Communication Technology could be used to improve access to quality, evidence-based education for your employees and the farmworkers they serve?
5. What type(s) of technology could work best?
6. What additional thoughts can you provided related to our topic of conversation?