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RESEARCH ARTICLE

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Career readiness: Finding a place for health and safety education

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Abstract

Background: Studies have identified gaps in health and safety knowledge and work practices of vocational students in the United States and abroad. Little is known about what, how, when, or if health and safety are taught and if the teaching that takes place is effective. Faculty skilled in their technical area may lack knowledge related to health and safety and pedagogy. This knowledge gap is compounded by a deficiency or absence of high-quality safety and health resources for vocational and technical college faculty, the use of outdated and often inaccurate information, and lack of any standardized assessment of knowledge and skills.

Methods: To identify these knowledge gaps, we conducted group interviews with auto body collision technology and machine tool technology faculty at two colleges.

Results: Most instructors reported a rapid transition from technical trade worker or business owner into their faculty role, with little support or education related to teaching. No instructor used a defined health and safety curriculum and materials or could describe the breadth safety skills required for their profession. Instructors tested and evaluated health- and safety-related skills on an ad hoc basis and said that workers and employers were ultimately responsible for job health and safety.

Conclusions: Standardized health and safety training is needed nationally and should be progressive and integrated with career-specific educational programs. It should ensure that students obtain knowledge and understanding of how to apply the principles of safety and health and communicate with employers about health- and safety-related issues.

KEYWORDS
auto body collision technology, career readiness, health and safety education, machine tool technology, vocational students

1 | INTRODUCTION

In 2018, nearly 20 million students were enrolled in postsecondary educational programs (ie, education beyond high school) in the United States. Of these, about 13.3 million were attending 4-year institutions, and 6.7 million were attending 2-year institutions,[1] of which 6.3 million were in public institutions. The National Postsecondary Student Aid Study surveys students from about 1500 public and private institutions participating in Title IV federal financial aid programs.[2] In 2015, Title IV schools awarded almost 1.5 million sub-baccalaureate occupational credentials, comprising 38% of all undergraduate credentials. Of the 38%, just under two-thirds were certificates rather than associate degrees.[3] Specifically, "23% of all undergraduate credentials awarded in 2015 were occupational certificates, and 15% were occupational associate degrees."[3] Public institutions awarded 61% and 69% of occupational certificates and associate degrees, respectively.[2,3] Currently, Minnesota has 41 public community colleges, with a total enrollment of about 180 000 students. Of these, just more than 59 000 are postsecondary career and technical education (CTE) students.[4]

Postsecondary CTE plays an increasingly important role in the US economy.[2,3] Individuals completing a 2-year sub-baccalaureate degree earn 20% to nearly 45% more than those completing only high school, although estimates vary widely. Salaries vary based on type of degree, field of study, age, sex, and race. Further, by 2020, it is projected that almost 45% of manufacturing jobs will require at least a 2-year associate degree.[3,5]

Despite the large numbers of students in postsecondary educational programs, mandatory educational standards are frequently lacking. According to the National Association of State Directors of Career Technical Education Consortium (NASDCTEC),[6] "The majority of states have the authority to adopt both secondary and postsecondary CTE standards, although most only exercise this authority at the secondary level." Rather, most states have policies that allow postsecondary institutions to select their own curricula and means of assessment; we know of no evaluation that has been conducted on safety and health training in CTE on a national basis and across trades.

Several studies have identified gaps in health and safety knowledge and work practices of vocational students in the United States,[7,8] and abroad.[9,10] Educational interventions designed with input from college instructors and specialized health and safety personnel have successfully increased students' knowledge of health and safety hazards and improved work practices.[7] Currently, health and safety are recommended, but not required as career cluster knowledge and skills.[11] However, little is known about what, how, when, or if health and safety is taught and if the teaching that takes place is effective.

The lack of safety and health training at the postsecondary level has been an ongoing concern of the National Institute for Occupational Safety and Health (NIOSH). NIOSH has been engaged in and supported efforts to develop and implement health and safety curricula for young workers since the early 1990s. Schulte et al[12] reviewed a number of national initiatives designed to ensure that vocational educational programs integrate health and safety information and emphasized the need for systematic evaluations of these programs. The authors concluded that, while occupational safety and health competencies are included in technical and vocational educational programs, there is minimal literature on implementation of occupational safety and health in CTE programs.

Faculty skilled in their technical area may lack knowledge related to health and safety[13] and pedagogy. This knowledge gap is compounded by a deficiency or absence of high-quality safety and health resources for vocational and technical college faculty, the use of outdated and often inaccurate information, and lack of any standardized assessment of knowledge and skills.[13]

The lack of safety and health training at the postsecondary level is exacerbated for students who enter the workforce in small enterprises, where they are not given ongoing opportunities to obtain the health and safety skills needed for a long career. Auto body collision technology (ABCT) and machine tool technology (MTT) are industries with a large percentage of small businesses[14] whose owners face unique challenges implementing health and safety regulatory requirements. Workers in these trades experience injuries and illnesses at rates substantially above average for many types of incidents[15] and are unlikely to receive safety and health training on the job.[16,17]

Workers in auto body shops repair, assemble, and paint vehicles. They may be exposed to chemical (eg, isocyanates and solvents), physical (eg, particles and noise), electrical, fire (eg, flammable liquids), and ergonomic hazards. They also subjectee to payment rates mandated by third party payers they feel increase the pace of work and encourage shortcuts in safety.[18] Workers in metal fabrication may be exposed to chemical (eg, metalworking fluids), electrical (eg, high voltage), physical (eg, unguarded machinery), and ergonomic (eg, awkward posture) hazards.

Technical Education for Health and Safety (TECHS) is a NIOSH-funded initiative conducted in partnership with two vocational colleges in Minnesota. The purpose of TECHS is to identify health and safety gaps in curriculum, and design, implement, and evaluate the effectiveness of new curricula in ABCT and MTT in two technical-vocational colleges. This paper presents findings from group interviews with ABCT and MTT faculty at colleges participating in the TECHS program. Additional discussion and review of finding is found in Bejan et al.[13]

2 | MATERIALS AND METHODS

2.1 | Human subjects

All study methods and surveys were approved by the HealthPartners Institutional Review Board (IRB). Participants signed informed consent forms and were compensated for their time.

2.2 | Question development

Health and safety teaching materials used in courses in the ABCT and MTT programs at one participating college were assessed in February 2013. Following a brief review, health and safety training materials were not found at college 2 and additional evaluation was not completed. This was followed by a review of published materials addressing safety and health in the collision repair and MTT trades. The review included peer-reviewed journal articles, trade journals, regulatory reports, and information provided by materials and equipment manufacturers. Findings were used to design questions for instructor discussion groups and surveys.

Discussion group questions covered five topics: (a) instructor background and transition from industry to teaching, (b) methods and materials used for teaching and testing safety, (c) graduates' skills and safety-related challenges when entering the workforce, (d) employee-employer communication about safety, and (e) type and format of safety and health teaching and test materials that instructors might want. Questions were open-ended to encourage participant interaction. The same questions were used with both ABCT and MTT instructors.

2.3 | Recruitment

Four key informant groups, two each with ABCT and MTT instructors, were held in February and March 2015. Instructors were eligible to participate if they taught full-time and had at least 1 year of teaching experience at their college. Trade-specific meetings were held in each college.

2.4 | Analysis

Key informant groups were recorded and transcribed. Written notes were taken during each session to help guide analysis of transcribed materials. Within each topic area, similar and different response patterns were sought between colleges and faculty members. Special emphasis was placed on identifying key concepts related to each question area.[19,20]

3 | RESULTS

3.1 | Demographics

Before participation instructors were asked to complete a brief survey that included demographic information and their teaching history. Six of six ABCT instructors participated in group discussions and completed surveys. Before teaching, they had worked in the industry a mean of 13 years (SD = 7, range = 4-21 years). Two instructors had owned their own collision repair shops. A third instructor owned a collision shop at the time of participation. Instructors had been teaching, on average, 22 years (SD = 12, range = 2-33 years) and teaching at their current college an average, 19 years (SD = 12, range = 2-33 years). All six instructors had completed a technical trade degree.

Six of seven MTT instructors participated in group discussions and completed surveys. The seventh instructor completed only the survey. One instructor was working full-time for a machining company in addition to teaching. Before teaching, instructors had worked in the industry, on average, 13 years (SD = 7, range = 3-22 years). Instructors had been teaching, on average, 13 years (SD = 11, range = 2-26 years) and had been at their current college, on average, 8 years (SD = 8, range = 2-19 years). Four of seven MTT faculty completed college and one had attended college. All MTT faculty had completed a technical degree.

3.2 | Instructor background and transition into teaching

Most faculty reported a rapid transition from technical trade worker or business owner to teacher. A typical comment from an ABCT faculty member was, "We're all technicians by trade, and then we all became teachers. So we're technicians first. We all know how to go work in the shops and then to come here. Nobody sat us down and said, 'Mike or Joe or Harry, you got to kind of figure out your own day and your lesson plans.' And we have companies that we work with for curriculum and things like that, and it helps us out greatly now to keep updated." Another ABCT faculty stated, "I was hired two days or three days before school started. I quite honestly didn't even know what a syllabus was." A third ABCT faculty member noted, "I got hired a week and a half before school started, I think. About a week and a half to start, and plus, I was still working at my other job, gave a week and a half notice."

For some MTT faculty, teaching had been a long-term goal: "I decided that I would go into teaching because I liked teaching other machinists how to do it, so I went back to school and got my bachelor's degree in business industry education, and I'm working here. I enjoy coming in every day and [I] learn something new every day from the students." Others transitioned into teaching because they were told or felt they had a natural inclination to train others: "Well, I was working in the shop, and I ended up training people in on second shift, and one of them happened to say, 'You did really good at that; you should be a teacher, and they're looking for someone' at such and such college."

However, MTT faculty expressed being inducted into teaching without support or background materials: "I'm kind of thrown into the fire. Because when I came in, I had a week and a half notice that I got the job, and 'here's the book, here's the workbook, and these are the classes you're teaching'." Another faculty member stated, "It was about four days before school started. They awarded me the job. Went down there, moved into your office, went to the first meeting, and the next Monday you started classes."

3.3 | Methods and materials used for teaching and testing safety

Three themes emerged as instructors spoke about teaching health and safety: ad hoc teaching methods; hazard identification within the teaching environment might place faculty or their institution at risk in event of an injury; and while important, safety is best left to the purview of students and/or their future employers.

No instructor used a defined health and safety curriculum and accompanying materials or could describe core skills required to work safely in their trade. They acknowledged that testing and evaluation of health- and safety-related skills was done on an ad hoc basis: "I don't. We don't test anybody on anything. We make sure, I mean, I make sure they know where the E-stops are and everything. The other safety thing that I can think of that I want to relay is the chuck wrench; that's part of your hand, it always comes off. Same with the wrench on the top of the Bridgeports; once it comes off, it's part of your hand. Stuff like that. We check to make sure that you don't touch any blades on the saw when they're running" (MTT). Another MTT faculty member stated, "It's more of a hands-on observation type of thing. It should be formalized more. It should be on a sheet laid out: these are the shop rules. Just like what we're talking about right now."

Stories were frequently cited as a means of teaching: "Past experience from me not wearing respiratory protection while priming on the job that led to my need for sinus surgery. That they need to

learn from my mistakes, because I probably wasn't taught or I didn't hear it when I went to college, but I'm sure my instructors told us to" (ABCT). Because of their ad hoc nature, stories did not have a set place in curricula.

When asked about training students to identify unsafe work practices, MTT instructors expressed concern about liability if a problem was not corrected: "Yeah, kind of because not all of us are safety experts. I mean, I know I'm not a safety expert, and I can say 'that looks unsafe.' Well, maybe it is, maybe it isn't, but now I wrote it down, so now you better fix it." Instructors said they needed checklists for students to sign to acknowledge that they were warned: "It's just really making it something that a student could sign-off on, and to me, that sign-off sheet; it's a good thing, there's no doubt about it but that's really to save your hind end" (ABCT). Another instructor stated, "Yes, the student was shown how to use the equipment. The student proved they knew how to actually physically use it. At the right time, will they use it? That's up to them, up to a point. But I have a check off to save my butt to prove I showed them" (ABCT).

Instructors often said that safety is each student's responsibility: "So I do show them those things right up front and explain to them, and we both have them sign that sheet saying that they know what happens if they don't wear them [eye protection] or that they're responsible, but I guess I, you know, I really try to stress that it's their responsibility to be safe for themselves." A similar statement was made by another faculty member: "I think, I don't know how well it works, but I tried to express to my students that safety is your responsibility, and you're the one who has to. Do you want to see them trees out there tomorrow? Then put your safety glasses on, and hopefully, if something ever happens, you'll get to see a tomorrow" (ABCT).

Although some instructors appeared to have set safety guidelines for working in the shop, they were not formally stated and clearly communicated to students. "I'm thinking about… 'cause if they are not wearing, if they have sandals on, if they have hair that's not pulled back or something, I stop it right there. It's my call to say,' 'That's not safe. I don't want to see you entangled in the machine.' We should have a better policy to have that power to say no" (MTT).

However, instructors also felt a sense of powerlessness with regard to enforcing specific safety requirements: "Why can't I enforce that? So, if we had something like this [formal safety policy], maybe it would be a different answer" (MTT). A similar perspective was expressed by ABCT faculty: "But I don't leave that stuff [dust masks] out anymore because it seems like it can just end up on the floor, and personally, I'm not sure where our responsibility is. Do we throw them out of class because they won't put all of this stuff on, or is it their personal responsibility? As long as we've told them, showed them, do we have to absolutely force them to do all this stuff?"

3.4 | Graduates' skills and safety-related challenges in the workplace

Faculty could not define a core set of health and safety skills that students need by graduation. Faculty generally defined overlapping sets of social and work skills they said were required for a successful career; while considered important, specific skills related to health and safety were rarely mentioned.

ABCT faculty most often cited work ethic as the skill needed by graduates; in some instances, students were portrayed negatively: "A lot of it is work ethics in the students. I've seen it going downhill in the last 10 years." Another ABCT faculty stated, "Well, kids are lazy. They think they can do everything by electronics. So that's where their work ethics went." Skills were also defined in terms of personal attributes such as, "Personality, attendance, attentiveness" or "Personality and common sense; [if] they had some common sense, they wouldn't hurt themselves." MTT faculty also noted the importance of personal work practices: "You don't ever want to get your hand off there until you're done tightening it. These are all things that we'll talk more about that are real hazards. And I also tell them, I say, 'This can be one of the safest careers you can be in if you use common sense'."

ABCT faculty noted the presence of hazards such as "flying objects" and the need for "safety glasses." Faculty also recognized the need to use respiratory protection; however, they were typically unclear as to the proper selection of personal protective equipment: "When they're spraying something, they would need a mask—either mask or fresh air. And then a dust mask." While recognizing the need for personal protective equipment, enforcement and shop-based rules were inconsistent: "We provide gloves for you to wear when you're mixing product or cleaning product, but I can't be standing there all the time. You have to make those choices" (ABCT). Most faculty recognized the need to use hearing protection: "I always tell them we have ear protection here. We have fresh air respirators here. We're going to demand that you wear safety glasses here."

Similarly, MTT faculty mentioned specific work practices in anecdotal stories: "Well, I'd start out with, and I do it myself, I've got at least one ring that, I immediately, when I'm out in the shop, it comes off. One of my friends lost his finger in industry because of his wedding ring getting caught on a machine, and it was a slow process, too. So that made a huge impression on me."

Although anecdotal stories may be useful, as in this instance they may also convey incorrect information. For example, a MTT faculty member implied that most injuries were secondary to the actions of another individual: "This guy is over here programming, not running the machine; he's got his glasses up on top of his head. The guy across the lab shatters the wheel, hits the back of the machine; it puts a huge dent in it. The guy's right on the other side. I said, 'Did you see what just about happened here?' He said, 'Well, I was only programming.' I said, 'You were programming; he wasn't programming.' Usually, when you get hurt, it's by another person. That's what I've seen in industry especially, but it could happen here."

MTT faculty also stressed the importance of understanding how to use specific types of machinery: "I know the biggest thing for me is identifying the machine and knowing what you're going to do before you do it. Don't come up to a machine and not know how to run it and think you're going to know how to run it right away." Although MTT faculty did not test safety-related knowledge, they typically assessed a student skills before allowing him or her to use a piece of

machinery: "Once I do a demonstration on a machine, I make sure that student—I stand there while they show me everything I just taught them as far as knowing where the E-stop, power switches are, knowing where the draw bar is, knowing what every lever does so you don't touch the wrong one at the wrong time and make a bad move."

3.5 | Employee-employer communication about safety

Faculty had a strong sense that health and safety should be left up to individual students in the training environment and/or their future employers. For example, a faculty member from ABCT stated, "And it's really, some of the questions you bring to light are managerial questions, basically. Shop owners and managers should be addressing these concerns. Period. I mean, when they take a new employee and there's orientations and everything. And I think that's where it should be addressed as far as, we do what we see and after that, on the internships, we get to explore it a little bit more, but it's really up to the managers and things. You got something wrong with your shop; fix it." An MTT faculty member made a similar comment: "So to train somebody properly on how to handle that [hazardous] situation, that's their [owner's] decision, because sometimes it may come down to a job choice or not; I guess [that] would be my opinion. So it kind of comes down to an individual choice. I don't know if that is something that you can teach or coach. It's something that's learned."

All faculty were reluctant to have students question a new employer: "I know I wouldn't if I was a new student coming into something." Although communication between employees and owners was recognized as important, faculty were unclear as to how communication skills could be taught: "My gosh, it's your livelihood on the line. I don't want to risk losing an eye or something. How would you do that? I don't know. But it would be nice to have that ability to go to a supervisor and say, 'I don't agree with your policy this way. I would like to see it this way because I think it's safer.' Yeah. Would people do that? I talk all the time, and I have a tough time doing that. I would be a little nervous if I went to a new job and questioned authority, basically. How would we do that?" (MTT).

Another typical statement from MTT was, "So that's going to be up to the student, once he gets into the industry, that there's not going to be an instructor watching him all the time. It's going to be on his own acknowledgment of what he learned, is what safety is, that he knows he can't take safety glasses off there. There's not going to be someone there watching, saying, 'Hey, put your safety glasses back on.' You could say you could go to a supervisor with safety concerns. Are they going to pick you apart, saying, 'Why are you worried about that?' I would be afraid of questioning someone with authority at a company if I'm new, saying 'I don't agree with your safety; this should be done' or, 'I think I should have different safety glasses.' I think that would be a big… I know I wouldn't if I was a new student coming into something. There's no way I would question a supervisor saying, 'Hey, I have an issue with your safety thoughts on this.' No. I'd never do that."

Although faculty were reluctant to train students how to speak with a supervisor about a hazardous situation, they also acknowledged having done so themselves: "I had a fresh college engineer graduate who designed a fixture that was questionable at best and handed the project in and they spent a lot of money on, and they wanted to run it. And I just told them that I wasn't comfortable and didn't think it was safe. They re-evaluated it and had an outside engineering company look at it and decide it was unsafe" (MTT).

3.6 | Type and format of other safety and health teaching and test materials that instructors might want

Faculty described using outdated materials for teaching or were unable to give examples of materials used. When asked to give an example of training materials, one faculty member replied, "The eyes one. I have an antique video; it's like 1965." In reference to the graphic nature of the video another faculty replied, "I use that too, but I make sure that they don't go to breakfast. It's that bad." Faculty typically describe ad hoc teaching from experience: "I show them experiences. I show them where I put a rod through my finger" (ABCT).

Instructors expressed a need for uniform safety policies that they are empowered to implement and enforce: "Well, I'd like to have this policy, and let's be honest here; I'd like to have some back up. I mean, I can only go so far. I'm an instructor. Where do I go after that if we get the policy? What's my next step? Do I tell the students to go home, like you said with the sandals? Or who do I go to for the next step" (MTT)?

Although not directly stated, ongoing challenges related to communications were expressed: "Well, we'll get a full range of personalities [among our students], and most of them are very good, and there are some communication skills. Quite a few communication skills where I can't even, to be honest with you, or understand some of them, and I got a number of them right now. Very nice people and everything. Nothing with that, but it's like, 'When I get my point across, are you asking the right questions?' How do you deal with that? I don't know. And some are really introverted, shy, and they're and some are just the opposite" (MTT).

4 | DISCUSSION

Although findings are based on a small number of faculty interviews, they provide insight into how health and safety training is perceived, implemented, and assessed in two dangerous technical trades. A review of licensure requirement for CTE teachers indicates widely varied standards within and between states as well as internationally.[21,22] There is a shortage of faculty with career-based technical training and a background in education and fewer still with trade-specific knowledge of health and safety. A review of teaching requirements among construction trade faculty indicates that most lack teaching experience and only 27% reported being mentored on

how to teach health and safety.[23] This is reflected in the data presented from the TECHS study, in which most faculty reported starting their teaching career shortly before the academic year commenced and having had little or no experience in postsecondary education.

The Carl D. Perkins Career and Technical Education Act of 2006 calls for "competency-based applied learning that contributes to academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, occupation-specific skills, and knowledge of all aspects of an industry, including entrepreneurship, of an individual."[24] Perkin IV Sec. 113(b)(2)(B) core indicators include "Student attainment of challenging career and technical skill proficiencies, including student achievement on technical assessments that are aligned with industry recognized standards, if available and appropriate."[24]

Both MTT and ABCT faculty failed to identify a core set of health- and safety-related skills and knowledge. They also recognized the ad hoc nature of safety training. This reflects the overall nature of safety and health training in small business, where most faculty were employed before teaching. Small enterprises are characterized by a lack of resources for worker training. Our previous focus groups found that health and safety was frequently left up to the workers; a typical worker comment was, "No one is going to do it for you." Most workers also said that owners did not adequately fulfill their obligations with regard to trainig and were more concerned about cost rather than providing a safe work environment.[18]

Both MTT and ABCT faculty said they communicate with students after a dangerous event or when reflecting on a previous injury. Faculty were ambivalent about teaching skills to help their students communicate with future employers about health and safety problems. While it is certainly true that employers have an ongoing responsibility in providing a safe workplace, this responsibility frequently goes incompletely filled. In the United States, data from the Collision Auto Repair Safety Study as well as the National Machine Guarding Program found poor compliance with Occupational Health and Safety (OSHA)-mandated health and safety training.[18,25] Among Canadian workers, respondents from the Statistics Canada Workplace and Employee Survey ($n = 5671$) indicated that only about 20% of workers received health and safety training during their first year at work.[26] Further, these data did not show that training was targeted towards high-risk occupations or young workers.

Because many employers fail to provide health and safety training even when OSHA-mandated, young workers may be employed in hazardous occupations without the knowledge or skills required to understand and remediate the safety and health problems that place them at increased risk of injury. At the technical college level, this is a missed opportunity based on misperception that training will take place within the workplace.

A large number of demands are placed on technical-vocational faculty. Among them is keeping abreast of technical changes in their field.[21] In a CareerBuilder survey, two of three (67%) employers said that they are concerned about the growing skills gap among American workers. About 55% of employers said that they have seen a negative impact on their business due to extended job vacancies, with a sizable proportion of these employers pointing to productivity issues, an increase in voluntary turnover, and revenue loss.[27] On the surface, teaching health and safety appears to be one more demand on faculty time that requires faculty master a new set of materials.

Nationally, an estimated 4000 different credentials are available, and most lack standardization and are not linked to career outcomes or job availability.[28] The large number of credentials makes it difficult for institutions and faculty to understand the value provided by requiring or encouraging students to obtain different credentials. To improve postgraduate success, many states are implementing competency-based policies and pathways in technical and vocational education.[29] In the context of health and safety, competency is difficult to ascertain, there are no consensus standards and little in the way of noncommercial trade-specific curricula available. OSHA, however, provides hazard-specific training (eg, lockout).

The inclusion of health and safety as a basic skill ought to be integrated into career and vocational-technical training at both the high school and postsecondary levels. To do so will require standardized curricula developed in conjunction with health and safety experts. Most technical school faculty will need to learn the fundamentals before they can effectively teach their students. New curricula should be developed in accordance with the principles of adult learning including the active participation of students, and hands-on experience.[7]

Faculty requirements in postsecondary education vary greatly. In general, there are substantially greater requirements in high school than in postsecondary institutions. According to NASDCTEC,[6] "The majority of states have the authority to adopt both secondary and postsecondary CT standards, although most only exercise this authority at the secondary level." An ABCT instructor made an illustrative statement: "It's good and bad all at the same time, I think, that in order to get this job, you don't have to have a teaching degree or a bachelor's degree. You just have to have x amount of hours in your field. They want you to have knowledge of your field. And once you get here, they give you a certain amount of time to complete a series of classes of vocational education."

It is clear from these discussion groups that teaching health and safety is problematic for technical college faculty. They enter technical and vocational colleges with a high level of trade-specific technical skills. They see the demands of daily teaching an increasingly diverse student body, perceived liability, and lack of authority as barriers to expanding curricula to include health and safety. This is aggravated by the perception that lessons they learned during their career represent the types of problems students are most likely to encounter during theirs. This leads to ad hoc teaching with no clear curriculum.

In many respects, ad hoc teaching is representative of what is seen in small businesses in general with regard to health and safety. Employers frequently lack workplace policies in general (eg, discrimination) and clearly defined health and safety policies and

training.[25] Hence, findings from technical college faculty may simply reflect broader problems faced by the small business community. Technical colleges could likely provide a great deal of value to future employers if students were well trained in multiple aspects of health and safety, including knowledge of OSHA regulations, workers' rights and responsibilities, hazard recognition and control, proper selection and use of personal protective equipment, and many aspects of trade-specific hazards.

Regardless of the reason, the skills required for a safe career are often seen as secondary to the skills required to complete the technical aspects of a job. Health and safety should be integrated into all levels of training (Figure 1). At the base of the pyramid, students engaged in the common career technical core are exposed to a wide range of skills and knowledge related to the exploration of different areas. This model works well when students start at a secondary school level or general studies at the postsecondary level. However, many technical education students start with occupation-specific training.[30]

Training materials are needed nationally for each of the three levels in Figure 1.[6] Training should be progressive and at its highest level integrated with career-specific educational programs. It should also ensure that students obtain both knowledge and understanding of how to apply the principles of safety and health.[8] Training should include a component of self-efficacy to help students improve their ability to communicate with their future employers.[31] Faculty reluctance to consider such training was evident throughout the interviews described in this paper.

In summary, we have numerous recommendations for improving health and safety education in technical and vocational training programs. Citing the National Governors Association,[32] "Content knowledge and critical thinking are taught together so that students learn problem-solving skills not as part of some separate academic program but at the same time they learn technical skills." The following recommendations are applicable, regardless of type of institution (eg, public, private, and nonprofit) and would further students' ability to safely enter and pursue their trade:

1. It should not be assumed that career and technical faculty have health and safety knowledge and skills based on the fact that they may have worked for many years within their field. Programs should provide support for, and, require faculty to receive training in health and safety. However, faculty expressed concern that this should not be done at the expense of other aspects of training.
2. CTE programs should include health and safety knowledge and skills as a core career-ready practice. This should include a mandatory number of contact training hours as well as reference to general and career-specific hazards.
3. Health and safety training should be developed in conjunction with content experts with at least 2 years of advanced health and safety training and certification from a recognized board (eg, industrial hygiene and occupational medicine).
4. Health and safety content should be free from the promotion of commercial products.
5. Training should be integrated into all courses during all years of study.
6. Health and safety training should be integrated into "real-world" problems.[33]
7. Student assessment should include the demonstration of job-specific skills such as the identification of hazardous situations and the proper selection and use of personal protective equipment.
8. Expectations with regard to obeying health and safety rules during training should be clearly stated. Faculty should have the

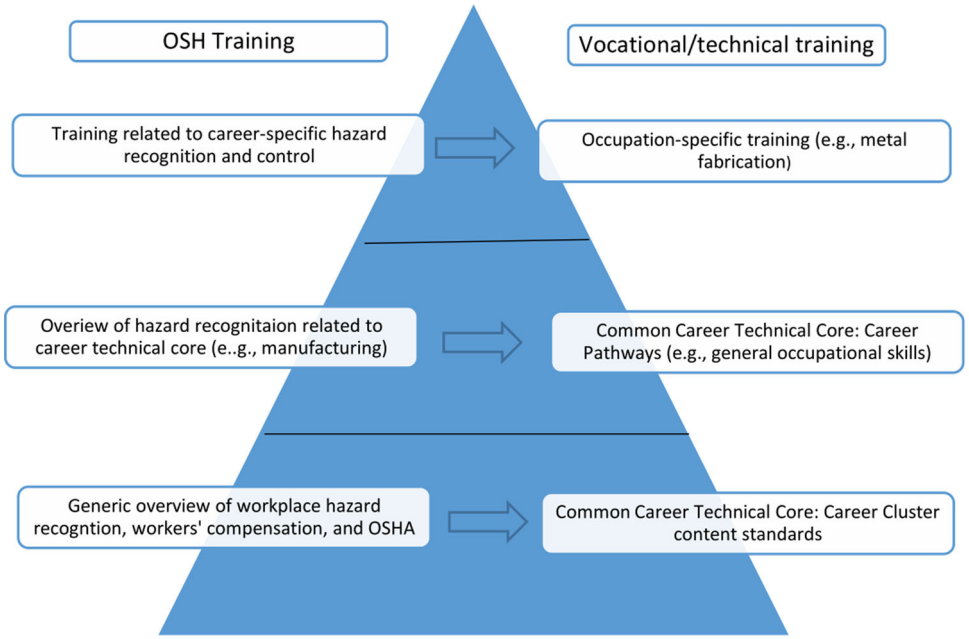

FIGURE 1 Aligning health and safety training with career pathways. OSH, occupational safety and health

authority to enforce health and safety regulations within the training environment.

9. Institutions should set aside funds to assure that equipment meets all safety standards. Faculty should not feel they are at risk if a problem is identified within their training facility.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

AUTHOR CONTRIBUTIONS

DLP was engaged in all aspects of this study. DR participated in interviews and the development and testing of educational materials.

ETHICS APPROVAL AND INFORMED CONSENT

All study methods and surveys were approved the HealthPartners Institutional Review Board (IRB). Participants signed informed consent forms and were compensated for their time.

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