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ORIGINAL RESEARCH

Athletic Training Educators' Perceptions and Integration of Digital Health

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Context: Digital health represents a transformative shift in health care, emphasizing patient-centric outcomes over mere technological advancements. Digital health tools include artificial intelligence, telehealth, augmented or virtual reality, wearables and sensors, and electronic health records to enhance patient care and outcomes. However, challenges persist in preparing future health care providers for this evolving landscape, particularly in athletic training programs.

Objective: To explore current trends in integrating digital health tools within professional athletic training programs. Specifically, we assessed educators' teaching practices related to digital and computer skills, their anxiety toward technology, and the incorporation of digital health tools in both classroom and clinical settings.

Design: Cross-sectional study.

Setting: Online survey.

Patients or Other Participants: One hundred twenty-eight athletic training educators from Commission on Accreditation of Athletic Training Education–accredited professional athletic training programs.

Data Collection and Analysis: Between February 2024 and April 2024, participants completed an online survey that explored teaching practices, technology anxiety using the Abbreviated Technology Anxiety Scale, and integration of digital health tools. Descriptive statistics were used for data analysis.

Results: Findings indicated that a significant portion of educators needed to be teaching foundational computer literacy or digital health equity. Most participants expressed low to mild technology anxiety. Although educators are open to adopting digital health tools, only 45% had previous preparation in digital health, suggesting a need for formal faculty training in this area. Despite this, there was a high level of interest in integrating digital health tools into curricula, though uncertainty remained about expanding Commission on Accreditation of Athletic Training Education standards related to digital health.

Conclusions: The study highlights a gap between the rapid advancement of digital health technologies and the current educational practices in athletic training programs. Enhanced instructional strategies and continued professional development focused on digital health tools are needed to prepare future providers. Addressing these gaps will ensure that emerging technologies are effectively integrated into athletic training education and future patient care.

Key Words: Telehealth, artificial intelligence, technology

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KEY POINTS

- Athletic training educators reported high familiarity and frequent personal use of digital health tools such as telehealth and wearables and sensors.
- Although participants self-reported low technology anxiety, 49.2% of athletic training educators reported poor to very poor artificial intelligence skills and rated artificial intelligence–based competencies for athletic training as 52% to 67% important.
- A gap in informed decision-making relative to digital health technologies, specifically augmented or virtual reality, mobile health, and machine learning, may negatively impact current instructional practices and future adoption behaviors.

INTRODUCTION

Digital health is a field of health care focused on the patient rather than the technology; however, in describing it, we often focus on the tools rather than the health outcomes. The integration of digital health "is about the proper use of technology for improving the health and wellbeing of people at individual and population levels, as well as enhancing the care of patients through intelligent processing of clinical and genetic data."[1,2] The rapid influx of digitalization in health care has presented opportunities for innovative engagement, delivery, and outcomes for patient care.[3,4] Healthcare 4.0 is a term for the data-driven use of digital health tools, which has enabled innovative care delivery models and reimagined the patient-provider relationship.[5] Digital health is a comprehensive term used to discuss any use of health information technology for patient care or health care support.[6] However, some digital health tools are specific to patient care (digital medicine) or disease management (digital therapeutics).[6] Digital health encompasses various technology applications potentially beneficial for health optimization, including collecting, calculating, analyzing, and disseminating electronic data. For this study, the term *digital health tools* refer to specific technologies and software such as artificial intelligence (AI), telehealth, augmented reality (AR) or virtual reality (VR), wearables and sensors, electronic health records (EHRs), mobile health, and machine learning.[7]

Artificial intelligence is a comprehensive term describing a computer program that can perform sophisticated operations and solve problems that have historically required human mental effort. Examples of AI include virtual assistants, medical image analysis, chatbots, assisted diagnosis and treatment, and fraud detection. *Machine learning* is widely viewed as a subdiscipline of AI,[8,9] which involves aggregated data analysis from multiple sources, including some combination of EHRs, mobile health, wearables and sensors, and AR/VR.[10] Machine learning is a specialized area within data science concerned with programs or systems that generate a predictive model from input data.

Telehealth refers to using communications technologies to provide health care at a distance. It includes phone or video chat for health consultations, sending and receiving messages, and remote monitoring. *Augmented reality and VR* are described as the use of reality technologies to enhance the surroundings by adding digital elements to a live view, often by using the camera on a smartphone or through a completely immersive experience that replaces a real-life environment with a simulated one using headsets, glasses, and virtual environments. *Wearables and sensors* include a variety of wearable objects or directly integrated options with the body to help monitor health and/or provide clinically relevant data for care, such as pressure, temperature, position, and force. Some examples of wearables and sensors include smart watches, wearable electrocardiographic monitors, pedometers, movement sensors, heart rate monitors, and accelerometers.

An *EHR* is defined as an electronic version of a patient's medical history that is maintained by the provider over time and may include all the key administrative and clinical data relevant to that person's care under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. Examples of EHRs include cloud-based software and physician-hosted systems such as EPIC or Cerner. Finally, *mobile health* is operationally defined as using mobile devices, such as a cellphone or a tablet, to support health care practices through applications. Examples include applications such as Calm, Mango, Shop Well, and TalkSpace.

The data suggest that these digital health tools have improved patient outcomes across multiple areas, such as identifying elevated concussion risk,[11] decreasing unnecessary emergency department visits,[12] and aiding in pain reduction and functional improvement.[13] The changing landscape of technology within health care presents several barriers and challenges that require teaching and learning opportunities to prepare future providers for these tasks.[14] Currently, the Commission on Accreditation of Athletic Training Education (CAATE) curricular content standards for athletic training include digital health through Standard 64 on health informatics and Standard 87 on biometrics.[2] In addition, the CAATE is supportive of athletic training programs using telehealth for clinical education opportunities.[2] However, the arts and sciences of digital health are expansive, including various skills, such as digital literacy, computer skills, online communication, and privacy and security standards, that educators typically assume learners are capable of as they enter their health profession program.[15] This is the premise of digital natives: that young people, specifically Generation Z learners born between 1995 and 2012, have high digital literacy, as they grew up alongside the development of technology.[16]

With the rise in patient care opportunities to use digital health tools, we must prepare future providers for jobs that may not exist yet or for tasks in their jobs that have yet to be performed. As digital health continues to expand, there is a need to explore how educators, specifically those within athletic training programs, integrate the tools and technologies into the classroom and clinical education. The zone of proximal development, a cornerstone of Vygotsky's sociocultural learning theory, suggests that learning is guided and mediated by social interactions with a more knowledgeable other: in this scenario, an athletic training educator.[17] However, if an educator's comfort zone in teaching does not include technology or digital health tools, they may be less likely to integrate them into the classroom, resulting in an educational gap for the learners.[18] The pedagogy of athletic training should transform and grow alongside that of health care, suggesting that educators need to leave their comfort zone to prepare athletic training students for digital health. Therefore, this study aimed to investigate the current trends of educators in professional athletic training programs concerning digital health. Specifically, the aims included exploring digital and computer skills teaching practices, faculty's perceived anxiety towards technology, and integrating various digital health tools in the classroom.

METHODS

Study Design

We used a cross-sectional study design to examine our research questions. The setting for this descriptive study was an online survey (Qualtrics Inc). We adhered to the STROBE guidelines for cross-sectional studies regarding data quality assessment and reporting.[19] The University of South Carolina Institutional Review Board approved the study.

Participants

After ethics approval, we recruited faculty and instructors of professional athletic training programs accredited by the CAATE between February 29, 2024, and April 29, 2024. The recruitment of participants was completed using email and social media. Social media posts were made on the researcher's Facebook, X, Instagram, and LinkedIn profiles, as well as direct messages and posts to specific interest group pages. We used email recruitment through 3 mechanisms: (1) direct communication to program directors listed on the CAATE website, asking them to forward it to all their faculty members; (2) Listservs of member organizations (Association for Athletic Training Education [AATE], National Athletic Trainers' Association [NATA] Educationalist, NATA Gather); and (3) the NATA research survey database (n = 879).

In total, we received 207 initial survey responses, with 85 from social media or email recruitment and 122 responses from the NATA research database, resulting in a 15% response rate and 92% completion rate from the database recruitment. From the 207 responses, we removed 5 who did not consent to participate and 19 who indicated they did not teach within a professional athletic training program. Due to the nature of the instrument, we removed 55 participants who still needed to complete the tool in its entirety. The final sample size was 128 educators. Demographics of the participants are provided in Table 1.

Table 1. Participant Demographics

Variable	Value
Age, mean ± SD (range), y	46 ± 10 (30–67)
Certified AT experience, mean ± SD (range), y	22 ± 9 (6–43)
Gender, No. (%)	
Man	49 (38.3)
Woman	76 (59.4)
Prefer not to report	3 (2.3)
Job title, No. (%)	
Program director	46 (35.9)
Core faculty (nonadministrative)	43 (33.6)
Coordinator of clinical education	29 (22.7)
Adjunct faculty	4 (3.1)
Other	3 (2.3)
Simulation director	2 (1.6)
Doctoral teaching assistant	1 (0.8)
Professional Athletic Training Program teaching experience, y, No. (%)	
0–1	3 (2.3)
2–5	21 (16.4)
6–10	34 (26.6)
11–15	17 (13.3)
16–20	25 (19.5)
21–25	19 (14.8)
More than 25	9 (7.0)
Highest degree earned, No. (%)	
Doctor of philosophy	60 (46.9)
Doctor of education	28 (21.9)
Doctor of health science	3 (2.3)
Doctor of athletic training	17 (13.3)
Other doctoral degree	1 (0.8)
Master's degree, athletic training	11 (8.6)
Master's degree, non–athletic training	8 (6.3)

Abbreviation: AT, athletic training.

Instrument

The primary researcher designed the instrument for this study using the best available evidence in terms of content and question design.[20,21] The instrument underwent content validation using a panel of 3 reviewers. Each reviewer initially commented on the survey and then scored the revised survey for relevancy (1–4) and clarity (1–4).[22] After 2 rounds of feedback, the tool achieved validation (relevancy, average = 0.99, universal = 0.94; clarity, average = 0.97, universal = 0.83).[22] The reviewers also provided feedback on the definitions and examples used for each digital health tool, and a two-thirds consensus vote deemed them appropriate for the study.

The final instrument contained 3 distinct areas: (1) teaching practices of computer literacy and other standards, (2) anxiety towards technology, and (3) integration of digital health tools. The survey contained 6 demographic questions about the participant, 15 background questions, 4 questions on CAATE standards, the 11-item Abbreviated Technology Anxiety Scale (ATAS), and the digital health tools section.

The ATAS is a practical instrument used to assess anxiety related to technology in populations such as students, health care providers, and professionals. The tool contains 11 prompts scored on a 5-point Likert scale (1 = *strongly*

Table 2. Teaching and Assessment Practice

Practice	No. (%) Yes	No
Teaching practices (I teach...)		
Foundational computer literacy and skills	24 (18.8)	104 (81.3)
Digital tools and technologies	87 (68.5)	40 (31.5)
Data security, including storage and sharing	70 (54.7)	58 (45.3)
Digital health equity	31 (24.2)	97 (75.8)
Data exploration and using data	92 (71.9)	36 (28.1)
Professionalism in the digital environment	78 (60.9)	50 (39.1)
Assessment (I assess students'...)		
Foundational computer literacy and skills	24 (18.8)	104 (81.3)
Use of digital tools and technologies	57 (45.6)	68 (54.4)
Data security, including storage and sharing practices	43 (33.6)	86 (66.4)
Digital health equity	10 (7.8)	118 (92.2)
Discovering and using data	79 (61.7)	48 (37.5)
Professionalism in the digital environment	46 (35.9)	82 (64.1)

disagree, 2 = *disagree*, 3 = *neither disagree nor agree*, 4 = *agree*, 5 = *strongly agree*) with the ratings specific to their personal feelings about themselves and technology.[23] The ATAS has strong psychometric properties that support its reliability (summated score internal consistency, $\alpha = .91$) and is positively correlated ($r = 0.17$) with measures of general anxiety.[23] Response to each question was summed to create a total anxiety score that ranged from 11 (no/low anxiety) to 55 (high anxiety). For this project, the research team grouped the participants into 4 categories based on their scoring: low anxiety (ATAS score of 11–21), mild anxiety (ATAS score of 22–32), moderate anxiety (ATAS score of 33–43), and high anxiety (ATAS score of 44–55).

The digital health tools section reviewed 7 digital health tools, including AI, telehealth, AR/VR, wearables and sensors, EHRs, mobile health, and machine learning. For each tool, the participant completed a series of 8 questions and a definition and examples of the digital health tool. The questions included familiarity (5-point Likert scale), frequency of use in personal life, integration of tool as part of classroom teaching and teaching about use in patient care (5 items based on the transtheoretical model of behavior change), comfort (0–100) with using the digital health tools and teaching about the digital health tools, evaluation of their skills (5-point Likert scale), importance to athletic training (5-point Likert scale), and perceived advantages (6-point Likert scale).[24] The competencies for AI[23] and telehealth[25] were provided, and educators were asked to rate from 0 to 100 their perceived importance of teaching and/or assessing these in athletic training students.

Procedures and Statistical Analysis

After receiving the recruitment email, each participant clicked the link to open the online survey, which contained informed consent. The participant then completed the instruments with the opportunity to close the browser, skip items they wished not to answer, or withdraw from the study. After data collection, data were compiled into a spreadsheet for descriptive analysis using Statistical Package for Social Sciences (version 28; IBM Inc).

RESULTS

Current Teaching and Assessment Practice

The participants expressed variation (no = 70, 54.7%; yes = 58, 45.3%) in receiving formal, organized training or extended instruction about digital health tools. Most educators reported that they were not teaching (*no* = 104, 81.3%) and not assessing (*no* = 104, 81.3%) foundational computer literacy skills. In addition, many were not teaching (*no* = 97, 75.8%) and not assessing (*no* = 118, 92.2%) digital health equity in their athletic training program. Educators shared that they were teaching about digital tools and technologies (n = 87, 68.5%) and data exploration/using data (n = 92, 71.9%). Table 2 provides an overview of digital and computer skills teaching and assessment practice.

Regardless of training, 89.8% of educators (n = 115) were in favor of their athletic training program adopting digital health tools and services (not in favor = 0, 0%; unsure = 13, 10.2%). Educators ranked Standard 64's perceived importance higher (87.20 ± 13.56 [range, 30–100]) than Standard 87's importance (75.39 ± 21.27 [range, 2–100]). Most participants (n = 65, 50.8%) were unsure if adding a CAATE standard relevant to digital health was important.

Technology Anxiety

The average total score on the ATAS was 22.05 ± 7.75 (range, 11–44), and the average item score was 2.00 ± 0.70 (range, 1–4). Overall, most participants were categorized as having either low (n = 61, 47.7%) or mild technology anxiety (n = 54, 42.2%). Few participants expressed moderate (n = 12, 9.4%) or high (n = 1, 0.8%) anxiety in the tool. Table 3 provides an overview of the educators' responses to the ATAS.

Digital Health Tools

Table 4 provides an overview of the participants' personal experiences with digital health tools. Participants were most familiar with EHRs (moderately and extremely = 84.4%), wearables and sensors (moderately and extremely = 68%),

Table 3. Participant Responses to Technology Anxiety Scale

Stem	No. (%)					Mean ± SD
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	
I am not a technology person	43 (33.6)	49 (38.3)	20 (15.6)	15 (11.7)	1 (0.8)	2.08 ± 1.02
I am reluctant to learn new features of technology	48 (37.5)	64 (50.0)	7 (5.5)	8 (6.3)	1 (0.8)	1.83 ± 0.85
I am uncomfortable using technology	54 (42.2)	50 (39.1)	12 (9.4)	8 (6.3)	4 (3.1)	1.89 ± 1.02
Technology does not improve my quality of life	55 (43.0)	61 (47.7)	7 (5.5)	2 (1.6)	3 (2.3)	1.73 ± 0.83
I feel out of control using technology	58 (45.3)	55 (43.0)	14 (10.9)	1 (0.8)	0 (0)	1.67 ± 0.70
I feel uneasy using technology	58 (45.3)	54 (42.2)	10 (7.8)	6 (4.7)	0 (0)	1.72 ± 0.80
I feel technology complicates simple tasks	41 (32.0)	41 (32.0)	33 (25.8)	13 (10.2)	0 (0)	2.14 ± 0.99
Keeping up with the newest technology is impossible	18 (14.1)	36 (28.1)	42 (32.8)	26 (20.3)	6 (4.7)	2.73 ± 1.08
I am inefficient with technology	38 (29.7)	53 (41.4)	20 (15.6)	14 (10.9)	3 (2.3)	2.15 ± 1.04
Using technology makes me nervous	56 (43.8)	48 (37.5)	16 (12.5)	7 (5.5)	1 (0.8)	1.82 ± 0.91
I am often annoyed when using technology	40 (31.3)	40 (31.3)	23 (18.0)	21 (16.4)	4 (3.1)	2.29 ± 1.16

and telehealth (moderately and extremely = 68%), which mirrored the personal use data, with 67.6% of participants stating they used a wearable or sensor daily, but contrasted drastically with telehealth, with 69.5% of participants reporting never using telehealth for personal use. Educators self-reported their digital health skills as good to excellent in EHRs (67.7%).

Table 5 details the educators' instructional experiences with the digital health tools concerning their importance in athletic training education, whether they used the tool in the classroom for instructional purposes, if they were taught about the tool for future patient care purposes, their comfort with the tools, and potentially their feelings on the future use of the digital health tools. Overall, participants expressed a need for more comfort with AI, AR/VR, mobile health, and machine learning, which also mirrored the current use and integration of the tools in the classroom. Participants noted the importance of EHR and telehealth within athletic training education.

The data in Table 6 reflect the educators' perceived importance of specific AI and telehealth competencies in athletic training. The perceived importances ranged from 52% to 82%, with telehealth competencies rated higher than AI competencies.

DISCUSSION

Foundational knowledge derived from the related areas of science, technology, engineering, and mathematics is essential for understanding the effects of functional loading and therapeutic interventions on human anatomic structures and physiological processes. The US Bureau of Labor Statistics includes athletic training among health care occupations classified as science, technology, engineering, and mathematics careers, affirming the importance of continuously incorporating the rapidly expanding body of knowledge relevant to health care. Our results highlight areas of opportunities related to the future implementation of digital health tools in educational programs.

Table 4. Personal Experiences with Digital Health Tools

	Artificial Intelligence	Telehealth and Telemedicine	Electronic Health Records	Augmented or Virtual Reality	Wearables and Sensors	Mobile Health	Machine Learning
Familiarity, No. (%)							
Not at all	5 (3.9)	1 (0.8)	0 (0.0)	27 (21.1)	1 (0.8)	38 (29.7)	63 (49.2)
Slightly	40 (31.3)	16 (12.5)	6 (4.7)	35 (27.3)	16 (12.5)	31 (24.2)	30 (23.4)
Somewhat	35 (27.3)	24 (18.8)	14 (10.9)	30 (23.4)	24 (18.8)	24 (18.8)	24 (18.8)
Moderately	37 (28.9)	64 (50.0)	45 (35.2)	29 (22.7)	55 (43.0)	26 (20.3)	9 (7.0)
Extremely	11 (8.6)	23 (18.0)	63 (49.2)	7 (5.5)	32 (25.0)	9 (7.0)	2 (1.6)
Personal use, No. (%)							
Daily	13 (10.2)	0 (0.0)	14 (10.9)	0 (0.0)	86 (67.7)	8 (6.3)	1 (0.8)
More than 3 days per week	11 (8.6)	0 (0.0)	5 (3.9)	3 (2.3)	5 (3.9)	7 (5.5)	5 (3.9)
1–3 days per week	25 (19.5)	2 (1.6)	13 (10.2)	2 (1.6)	4 (3.1)	10 (7.9)	5 (3.9)
Every other week	32 (25.0)	37 (28.9)	47 (36.7)	12 (9.4)	7 (5.5)	17 (13.4)	13 (10.2)
Never	47 (36.7)	89 (69.5)	49 (38.3)	111 (86.7)	25 (19.7)	85 (66.9)	104 (81.3)
Skills with tool, No. (%)							
Excellent	4 (3.1)	5 (3.9)	32 (25.2)	0 (0.0)	28 (21.9)	9 (7.1)	2 (1.6)
Good	15 (11.7)	38 (29.7)	54 (42.5)	16 (12.5)	37 (28.9)	18 (14.2)	3 (2.4)
Acceptable	46 (35.9)	58 (45.3)	31 (24.4)	28 (21.9)	43 (33.6)	31 (24.4)	20 (15.9)
Poor	37 (28.9)	21 (16.4)	8 (6.3)	34 (26.6)	16 (12.5)	22 (22.0)	26 (20.6)
Very poor	26 (20.3)	6 (4.7)	2 (5.1)	50 (39.1)	4 (3.1)	41 (32.0)	75 (59.5)

Table 5. Instructional Experiences with Digital Health Tools

	Artificial Intelligence	Telehealth and Telemedicine	Electronic Health Records	Augmented or Virtual Reality	Wearables and Sensors	Mobile Health	Machine Learning
Importance in athletic training education, No. (%)							
Not at all	1 (0.8)	0 (0.0)	0 (0.0)	9 (7.0)	0 (0.0)	0 (0.0)	10 (7.9)
Somewhat unimportant	6 (4.7)	9 (7.0)	0 (0.0)	20 (15.6)	3 (2.3)	10 (7.9)	12 (9.4)
Undecided	24 (18.8)	11 (8.6)	1 (0.8)	48 (37.5)	8 (6.3)	53 (42.1)	75 (59.1)
Somewhat important	65 (50.8)	55 (43.0)	11 (8.7)	39 (30.5)	70 (54.7)	46 (36.5)	19 (15.0)
Very important	32 (25.0)	53 (41.3)	115 (90.6)	12 (9.4)	47 (36.7)	17 (13.5)	11 (8.7)
Using tool in the classroom, No. (%)							
No and do not plan	49 (38.3)	73 (57.0)	41 (32.0)	92 (72.4)	52 (40.9)	94 (73.4)	111 (87.4)
No, plan in 6 months	32 (25.0)	16 (12.5)	11 (8.6)	24 (18.9)	12 (9.4)	9 (7.0)	8 (6.3)
No, plan in 30 days	4 (3.1)	2 (1.6)	0 (0.0)	0 (0.0)	1 (0.8)	0 (0.0)	0 (0.0)
Yes, less than 6 months	30 (23.4)	8 (6.3)	5 (3.9)	4 (3.1)	11 (8.7)	6 (4.7)	2 (1.6)
Yes, more than 6 months	13 (10.2)	29 (22.7)	71 (55.5)	7 (5.5)	51 (40.2)	19 (14.8)	6 (4.7)
Teaching about the tool for patient care, No. (%)							
No and do not plan	59 (46.1)	48 (37.8)	23 (18.1)	94 (74.0)	42 (33.1)	84 (65.6)	112 (88.2)
No, plan in 6 months	41 (32.0)	17 (13.4)	7 (5.5)	19 (15.0)	12 (9.4)	7 (5.5)	8 (6.3)
No, plan in 30 days	7 (5.5)	4 (3.1)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.6)	0 (0.0)
Yes, less than 6 months	19 (14.8)	15 (11.8)	9 (7.1)	5 (3.9)	14 (11.0)	10 (7.8)	2 (1.6)
Yes, more than 6 months	2 (1.6)	43 (33.9)	88 (69.3)	9 (7.1)	59 (46.5)	25 (19.5)	5 (3.9)
Comfort, 0–100 scale, mean ± SD							
Using tool in the classroom	45.9 ± 21.2	63.3 ± 26.2	79.2 ± 25.1	33.1 ± 60.6	68.8 ± 27.6	43.6 ± 33.9	22.5 ± 28.7
Teaching about the tool	39.0 ± 27.5	67.8 ± 23.8	83.7 ± 22.7	35.0 ± 29.8	70.5 ± 26.2	47.4 ± 34.0	25.8 ± 30.7
Future use, No. (%)							
Mainly advantages	10 (7.8)	27 (21.3)	77 (60.2)	12 (9.24)	48 (37.8)	15 (11.7)	7 (5.6)
More advantages	47 (36.7)	66 (52.0)	45 (35.2)	42 (32.8)	60 (47.2)	46 (35.9)	16 (12.7)
Undecided	46 (35.9)	24 (18.9)	4 (3.1)	47 (36.7)	14 (11.0)	45 (35.2)	66 (52.4)
More disadvantages	8 (6.3)	6 (4.7)	0 (0.0)	5 (3.9)	1 (0.8)	2 (1.6)	3 (2.4)
Mainly disadvantages	1 (0.8)	0 (0.0)	2 (1.6)	2 (1.6)	2 (1.6)	1 (0.8)	0 (0.0)
Not informed enough	16 (12.5)	4 (3.1)	0 (0.0)	20 (15.6)	2 (1.6)	19 (14.8)	34 (27.0)

Table 6. Perceived Importance of Competencies Specific to Athletic Training

Competency	Mean ± SD
AI competencies	
Basic knowledge of AI	64.74 ± 28.53
Social and ethical implications of AI	67.45 ± 27.40
AI-enhanced clinical encounters	56.57 ± 27.39
Evidence-based evaluation of AI-based tools	65.22 ± 29.59
Workflow analysis for AI-based tools	52.90 ± 27.83
Practice-based learning and improvement regarding AI-based tools	58.08 ± 28.97
Telehealth competencies	
Patient safety and appropriate use of telehealth	80.13 ± 19.42
Access and equity in telehealth	78.33 ± 21.97
Communication via telehealth	78.66 ± 20.51
Data collection and assessments via telehealth	70.09 ± 23.08
Technology for telehealth	70.83 ± 22.93
Ethical practices and legal requirements for telehealth	82.92 ± 19.66

Current Teaching and Assessment Practice

Educators' adoption of digital health tools showcases the rapid growth and advancement of technology in health care. An overwhelming majority of respondents favored the adoption of digital health tools, and 81% agreed or strongly agreed that such technologies would revolutionize the future of medicine. In many circumstances, the decision to use a digital health tool requires specialized knowledge for the proper interpretation of the information that it provides.[26] However, instruction in computer literacy skills and digital health equity are significantly lacking in educational programs, potentially impacting students' abilities to properly collect, calculate, analyze, and disseminate data impacting clinical outcomes. Digital health equity is both a process and an outcome focused on the access to, experience with, and design of digital health tools.[27] Access to technology, broadband internet, and other tools to take part in the digital health environment can be impacted by digital determinants of health and digital literacy.[28] Digital health equity also explores implicit tech bias in tools such as machine learning and AI, which are modeled on inputs that can create algorithmic limitations based on race, gender, and other patient descriptors.[29] Educators should begin by teaching about these concepts in their curriculum and then assessing digital health equity through activities. For example, an athletic training student could explore and report the internet access of the community they are assigned for clinical education by navigating zip code tabulation data.

A scoping review from 2021 exploring digital health course topics identified that 50% focused on health care informatics, 24% on EHR skills, 9% on computer literacy, 9% on telehealth, 6% on basic programming, and 3% on mobile health.[30] Athletic training programs, at either the professional or postprofessional level, as well as continuing professional development opportunities, should consider the intersectionality of technology and health care in creating student learning experiences. The data from our study suggest that a comprehensive digital health unit may be useful. Researchers from a European medical school created a 3-week digital health elective module that resulted in significant knowledge gains that would influence their work in the next 5 years despite the lack of information in the traditional curriculum.[31] Other opportunities include a postprofessional specialty certification in digital health, similar to the certificate on computing in medicine that was introduced at a medical school in 2016 that resulted in learner computer literacy achievements.[32]

Moreover, a lack of formal, organized training of educators is considered a barrier to success in the instruction and successful implementation of digital health tools. Educators are willing to adopt these tools, but a need for more confidence and skill to implement them showcases the need for structured continuing education opportunities. Athletic training students need instruction that prepares them for clinical implementation of emerging technologies, and practicing athletic trainers (ATs) largely depend on the current community of educators for continuing education needs. Thus, the self-perceived competence of athletic training program faculty members to provide instruction in technology-related areas may be an essential indicator of the profession's readiness to incorporate new technologies in clinical practice, which has the potential to expand current professional roles.[33]

Educators are split on expanding CAATE standards related to digital health tools. In our review of the 2020 CAATE Standards, we identified 2 standards (64 and 87) that clearly identified digital health. Many respondents viewed CAATE Standard 64 as necessary compared with CAATE Standard 87. This contrasts with other viewpoints that argue that ATs can impact their organization by adopting principles and skills from performance models such as the high-performance model, which relies on performance and biometric data to influence outcomes.[34] Perhaps a specific CAATE standard is needed to ensure that athletic training students receive instruction on digital health tools, foundational computer literacy skills, and other avenues embracing technology. In addition, the expansion of digital health in the standards would ensure alternative sources of evidence for clinical decision-making beyond the traditional experimental research paradigm and null hypothesis significance testing, such as clustering, decision trees, and random forest. Although educators may choose to integrate digital health knowledge, skills, and tools across the curriculum in clinical care, decision-making, and communication, the standards related to these areas allow for institutional autonomy. For example, a program could choose to consider digital health tools for things such as CAATE Standard 73 specific to interventions with the use of AR/VR for therapeutic rehabilitation or

CAATE Standard 71 with the use of telehealth to obtain a medical history as part of a patient interview. The CAATE standards guide teaching and learning; the document does not state what you cannot do. The CAATE does not preclude digital health from being taught simply because it is not explicitly listed in a standard. However, the self-selection of how and when would not standardize the process such that, at minimum, all athletic training students are exposed to digital health. We recommend that educators in athletic training programs consider teaching and assessing digital health across the curriculum standards while simultaneously advocating for a revision to Standard 87 to include other digital health tools outside of wearables and sensors. At the time of this publication (November 2024), the CAATE is in the process of a 5-year comprehensive review of the professional athletic training program standards to identify areas for improvement and innovation.[35] The November 2023 CAATE Town Hall meeting provided an overview of the revision process and open comment period in late 2025.[35] We believe our data can be used to inform educators to advocate for a revision, rather than an addition, of a standard surrounding digital health.

Technology Anxiety

Overall, participants expressed low or mild technology anxiety. Technology anxiety is defined as an emotional response arising from the use of or thoughts of having to use technology.[23] The integration of tech-based infrastructure into athletic training education has been slow. Previous research identified that athletic training educators used technology to manage information, support varied learning styles, provide visual examples, and engage students.[36] Other data from athletic training have encouraged the use of application-based technology[37] and simulation-based technology[38] to deliver content. However, there is a need to explore digital health tools. The tool used to explore technology anxiety, ATAS, generalized one's approach to technology, suggesting that athletic training educators found value in technology. Still, we cannot discern if the participant had in mind technology such as laptops and smartphones or digital health tools. The data give us the leverage to integrate digital health tools following the diffusion of innovation theory. In this model, individuals are assigned to groups regarding the spread and adoption of technological advancements.[38] The groups include innovators, early adopters, early majority, late majority, and laggards. As we continue to explore the integration in athletic training programs, we must use the foundation that most educators are not experiencing anxiety about technology, making them excellent candidates for the early majority. Innovators and early adopters of digital health in athletic training must be stewards of their advancements by showing their efforts through model practice presentations and education technique manuscripts.[39]

Digital Health Tools

The rapid expansion of AI has allowed for creative use of the systems in teaching and clinical practice. As noted in previous research, AI has the potential to streamline the diagnostic process, create individualized care plans emphasizing a patient-centered approach, and minimize human error, resulting in improved patient safety.[40] Several generative AI tools have emerged, including OpenAI, Microsoft Copilot, and Google Gemini, that can accept text input to develop stories, then pull information from live sources on the web, and create images. The relatively recent emergence of ChatGPT may have influenced respondents' interpretation of AI, which primarily relates to technology designed to generate narrative text on a selected topic. Medical students have expressed positive attitudes towards AI while noting the need for a structured process to learn how to integrate the tool.[41] A systematic review of ChatGPT's use in health care education and practice identified that 96.7% (n = 58 of 60) of articles mentioned concerns with ethical and legal issues surrounding the platform.[42] Although 96% of our participants reported being familiar with AI (ie, *slightly*, *somewhat*, *moderately*, or *extremely*), and 75% considered related knowledge and skills to be somewhat or very important, it is important to consider why 46.1% of the respondents stated they currently did not and do not plan to change their decision on teaching about AI for patient care. The root cause of the decision could be the lack of knowledge on how AI could be used for patient care, such as creating rehabilitation programs, time- and cost-saving efforts, and personalizing care plans. Other reasons could be safety, security, and the inaccuracies that chatbots have the potential to expose learners to.

Telehealth has grown in use and popularity after the COVID-19 pandemic. In athletic training, previous literature has identified possible teaching and assessment for telehealth practices that resulted in satisfied student outcomes and demonstration of proficiency with the skills of telehealth using a standardized patient encounter.[43,44] Other methods to teach and assess telehealth competencies have been demonstrated in peer health professions, such as a one-time workshop and subsequent objective structured clinical examination.[45] Data from ATs have suggested that one of the most important facilitators to the integration of telehealth was previous exposure.[46,47] For educators, the duty falls within the curriculum decision to expose students to tools and technology that could benefit their future clinical practice.

The participants' responses on the integration of AR/VR suggested that most were undecided on the importance of the digital health tool in athletic training education, with only 8.6% using AR/VR in class and 11.0% teaching about the potential use of the tool for patient care. The decision here seems based on comfort, with participants expressing 33% to 35% comfort in using or teaching about the tools. Immersive VR can be a valuable tool for orthopaedic skills.[48] In addition, there have been noted benefits of using AR/VR for long-term rehabilitation that athletic training students could benefit from exposure to for future patient care integration.[49] The future of AR/VR within medical documentation and emergency care is promising, and it stands firmly as one of the most influential digital health tools of the next decade for health care.[50,51]

CAATE Standard 87 explores the use of biometrics and physiological monitoring systems, which are defined by the CAATE as "measurement and analysis of physical characteristics and activity" and "ongoing measurement of a physiological characteristic" with examples such as "heart rate monitors, pedometers, and accelerometers" listed.[2] As these digital health tools are commonplace in society, it was not surprising that educators felt more comfortable using the tools. Interestingly, 33.1% of educators reported that they did not teach about using wearables and sensors in their program. These data could be due to another educator focusing on Standard 87 information in another course; however, it should be noted that wearables and sensors could be integrated throughout multiple courses, including primary care, orthopaedic evaluations, and rehabilitation planning. There is a need to continue the advancement of ATs within this area of data science with skills specific to the organizational environment, managing an athlete's data, and analyzing the data.[52]

Medical documentation in athletic training continues to be an area of critical deficiency. The use of pen and paper documentation has slowly been replaced with tools such as electronic medical records and EHRs. Athletic trainers continue to report technological concerns as a barrier to medical documentation.[53] Researchers have shared evidence supporting the use of academic-based EHR to improve attitudes and future adoption of positive documentation behaviors.[54] Over 95% of athletic training educators in our study shared that an EHR is advantageous for future use, denoting that positive talk should occur in the classroom. There could be a barrier to use through clinical education. Future research should explore the use of EHRs at clinical education sites and how preceptors view their comfort and use of the tool. The behaviors identified could bring light to the continued gap in EHR use.

A majority of participants (66.9%) shared they had never used mobile health for personal use. This could be due to a terminology issue surrounding what mobile health includes, resulting in a lack of familiarity and skills with the tool. This personal perception and use of mobile health will impact the integration in the classroom. We recommend that educators explore mobile health applications by encouraging students to download and use them during clinical education. Another opportunity is to discuss mobile health during interprofessional education opportunities to learn about applications used across various health care disciplines.

Machine learning algorithms focus exclusively on how computers can use data to learn strategies and behaviors within specific contexts. Examples include logistic regression, decision trees, and ensembles (bagging, boosting, random forest). Machine learning is particularly important to athletic training due to its potential for transforming research methods used to inform clinical decision-making.[55,56] Our results identified machine learning for patient care as the area of digital health that respondents felt least capable of teaching, with 81% rating their knowledge as poor or very poor and 88% reporting that they did not plan to start teaching about machine learning in the next 6 months.

Limitations and Future Research

Our study is limited by the small sample size. Although self-selection bias is typical of anonymous, web-based survey research, the results suggest a variety of responses across the spectrum of technology adoption. However, the online survey may have been a deterrent for those with higher levels of technology anxiety, as they may not regularly check email or social media, which was used for recruitment. The low response rate from the NATA Research Service has continued to plague professional behavior and advocacy research. The followers, connections, and subscribers to the accounts used to post the recruitment flyers could be built on shared interest, leading to participants that are more engaged in digital health. However, the research team believes the benefits of increasing survey participation via social media outweighs the potential bias in the gathered responses

It is important to note that although the digital health categories were assessed in isolation, some overlap among categories is unavoidable in clinical practice, which may have impacted educators' perceptions and added a layer of complexity. For example, options to calculate heart rate variability range from the output of a pulse monitor attached to the body (ie, wearable sensor) to measurements derived from a mobile device app transmitted to a cloud server (ie, mobile health).

Future research should consider exploring how AI can continue to be used in health care education for things such as teaching and assessment development, such as test questions, case scenarios, and problem-based learning assignments. A previous educational technique study in athletic training explored the use of ChatGPT to curate educational content; however, there is a need to investigate the accuracy and effectiveness of AI-generated scenarios.[57] The outcomes suggest that there is a need for specific didactic learning opportunities, clinical education experiences in digital health environments, and competence assessments related to digital skills and tasks.

CONCLUSIONS

The findings from our study underscore a critical juncture in the integration of digital health tools into athletic training education. Despite most educators expressing support for adopting digital health tools and reporting relatively low levels of technology anxiety, there remains a notable gap in foundational training and assessment in digital health literacy. Specifically, many educators lack formal instruction in digital health tools, which could effectively impact their ability to teach and use these technologies in clinical settings. This disparity highlights the need for a more structured and comprehensive approach to integrating digital health education into athletic training programs. This is reflected in the educators' mixed familiarity and comfort with advanced digital tools such as AI, AR/VR, and mobile health applications. The discrepancy between high familiarity with EHRs and lower comfort levels with other digital health tools suggests that although foundational tools are more integrated into practice, advanced technologies remain underused and underexplored.

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