Journal of Athletic Training 2017;52(12):1121–1130
doi: 10.4085/1062-6050-52.12.20

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original research

Examining the Environmental Effects of Athletic Training: Perceptions of Waste and the Use of Green Techniques

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Context: Environmental sustainability is a critical concern in health care. Similar to other professions, the practice of athletic training necessitates the use of a large quantity of natural and manufactured resources.

Objective: To examine the perceptions of the waste produced by the practice of athletic training and the green practices currently used by athletic trainers (ATs) to combat this waste.

Design: Mixed-methods study.

Setting: Field setting.

Patients or Other Participants: A total of 442 ATs completed the study. Sixteen individuals participated in the qualitative portion.

Main Outcome Measure(s): Data from sections 2 and 3 of the Athletic Training Environmental Impact Survey were analyzed. Focus groups and individual interviews were used to determine participants' views of waste and the efforts used to combat waste. Descriptive statistics were used to examine types of waste. Independent *t* tests, χ^2 tests, and 1-way analyses of variance were calculated to identify any differences between the knowledge and use of green techniques. Interviews and focus groups were transcribed verbatim and analyzed inductively.

Results: Participants reported moderate knowledge of green techniques (3.18 ± 0.53 on a 5-point Likert scale). Fifty-eight percent (n = 260) of survey participants perceived that a substantial amount of waste was produced by the practice of athletic training. Ninety-two percent (n = 408) admitted they thought about the waste produced in their daily practice. The types of waste reported most frequently were plastics (n = 111, 29%), water (n = 88, 23%), and paper for administrative use (n = 81, 21%). Fifty-two percent (n = 234) agreed this waste directly affected the environment. The qualitative aspect of the study reinforced recognition of the large amount of waste produced by the practice of athletic training. Types of conservation practices used by ATs were also explored.

Conclusions: Participants reported concern regarding the waste produced by athletic training. The amount of waste varies depending on practice size and setting. Future researchers should use direct measures to determine the amount of waste created by the practice of athletic training.

Key Words: environmental health, conservation of natural resources, waste management

Key Points

- Of the athletic trainers surveyed, 59% believed that the practice of athletic training produced substantial waste. However, only 38% felt sufficiently educated in methods of sustainability to change their practice.
- The types of waste cited most commonly were plastics, water, and paper for administrative use.

Humanity's effects on the environment are at an all-time high.[1] Overconsumption of the earth's natural resources combined with ever-exploding population rates means that, unless consumption habits change drastically, the chances of successfully providing for future generations will continue to diminish.[1,2] *Environmental sustainability* is a philosophy that promotes habitual behaviors in an effort to create a vibrant economy and precipitate an optimal quality of life while respecting the need to sustain natural resources and protect the environment so that future generations can live in a world the present generation enjoyed but did not diminish.[3] Environmental sustainability techniques are ideas and practices often used to conserve the earth's natural resources. Behaviors aimed at improving environmental outcomes are referred to as "green" or "greening."[4]

Health care facilities are among the largest producers of waste.[5] Medical waste includes solid waste (eg, trash, garbage), biohazard waste (eg, "sharps," human products), and hazardous chemical waste (eg, pharmaceuticals, disinfectants).[5] Common green techniques in health care are waste reduction and conservation of natural resources using basic efforts such as reducing, reusing, and recycling. Specific green techniques include altering purchasing practices (eg, buying in bulk, purchasing recycled goods) and implementing facility upgrades (eg, timers for lights, foot control pedals for water sources).

The practice of athletic training generates medical wastes in a similar manner to other health professions. However, the connection between the daily actions of an athletic trainer (AT) and the health of the environment is not often

explored. The AT need only reflect on his or her daily practice in terms of how many ankles were taped, how much water was thrown out, how many paper forms were completed, and how many items went into a trash can versus a recycling bin to start to consider the cumulative environmental results of one's clinical practice.[6] Previous researchers[7] suggested that ATs' opinions of environmental sustainability were positive. Therefore, the purpose of this study was to determine ATs' knowledge of environmental sustainability techniques, identify the types of waste produced by the practice of athletic training, and ascertain what, if any, green techniques ATs are currently using to minimize waste.

METHODS

This study was part of a larger exploration of the attitudes toward and perceptions of environmental sustainability among ATs[7] that employed a mixed-methods design. We used the Athletic Training Environmental Impact Survey (ATEIS), which is a valid and reliable tool used to measure the environmental effects of the clinical practice of athletic training.[7] Sections 3 and 4 of the ATEIS explore ATs' views of the types of waste generated by the practice of athletic training. Section 3 assesses the participant's knowledge of green techniques and views of these techniques specific to the practice of athletic training. Section 4 focuses on institutional practices with questions such as, "Does your place of employment have an environmental sustainability leader and/or committee?" and, "Do you currently recycle materials in your place of practice?" Then focus groups and 1-on-1 interviews were conducted using a semistructured format to further investigate the waste produced. One-on-one interviews supplemented focus-group data to reach saturation.

Participants and Sampling

A total of 3500 certified members of the National Athletic Trainers' Association (NATA) were specifically targeted. Refer to "Attitudes and Perceptions of Environmental Sustainability in Athletic Trainers"[7] for further information on the sampling procedures. The host institution's review board approved the study, and all participants acknowledged informed consent before beginning the survey. Those who participated in the qualitative portion provided informed consent before the interview. A total of 442 participants, 216 males (48.9%) and 224 females (50.7%; 2 respondents did not indicate sex), completed the survey. Participants were given an opportunity to continue with the study upon survey completion. Of the 442 survey respondents, 39 (8.8%) indicated a desire to participate in the qualitative portion. Two focus groups (10 participants: 5 males [50%] and 5 females [50%]) were assembled based on the participants' availability. Focus groups were supplemented with individual interviews (6 participants: 4 males [80%] and 2 females [20%]) in an attempt to reach data saturation.

Data Collection

Section 3 of the ATEIS demonstrates the participant's knowledge of green practices, whereas section 4 of the ATEIS indicates the AT's perceptions of waste produced by the practice of athletic training and identifies specific green techniques and institutional practices used to combat this waste. The survey was distributed via SurveyMonkey (http://surveymonkey.com, Portland, OR). We conducted interviews and focus groups to expand upon ATs' views regarding environmental sustainability. All qualitative data were collected using a semistructured interview guide to avoid bias. Participants who were unable to join a focus group were solicited for 1-on-1 interviews via e-mail. Data collection continued until data saturation was achieved.

Data Analysis

Participant responses for section 3 were tallied in a subscore that represented the participant's overall knowledge of environmental sustainability. Scores ranged from 1.00 (*little to no knowledge*) to 5.00 (*very knowledgeable*). A score of less than 3.00 indicates a lack of knowledge. The remaining survey data were analyzed using descriptive statistics. Independent t tests, χ^2 tests, and 1-way analyses of variance were used to determine differences between the knowledge and use of green techniques. The level of significance was set at $P > .05$ for all statistical analyses.

The first focus group was conducted via teleconference. The second focus group was conducted in person in conjunction with a national continuing education event. Data from both sessions were recorded and transcribed verbatim.

Qualitative data were analyzed to extract significant comments or phrases related to the waste produced by athletic training practices using the Creswell Data Analysis Spiral.[8] This multistep process is preferred as it allows the researcher to analyze the data in circles rather than by a linear approach.[8(p142)] All extracted data were coded, categorized by meaning, and clustered into themes.

Trustworthiness

Trustworthiness was established through peer debriefing (W.A.P.), member checks, and the use of rich description in the "Results" section. Rich description allows both the participant's behavior and the context to clearly illustrate the participant's emotions, thoughts, and perceptions about the topic. Once we analyzed the data, we reconstructed the themes to create a detailed analysis of the ATs' perceptions of the waste produced by the clinical practice of athletic training. The qualitative results were then returned to randomly selected members of the focus groups and interview sessions to review for authenticity. Fifty percent ($n = 8$) of the qualitative respondents (5 from the focus group and 3 individual interviewees) participated in the member-checking process.

RESULTS

Knowledge of Green Techniques

The mean knowledge score was 3.18 ± 0.53, indicating that the participants self-reported a moderate knowledge of green techniques. A 1-way analysis of variance was used to determine how ATs' knowledge of green techniques varied by district. No difference was found between knowledge of green techniques and NATA district ($F_{9,429} = 1.23$, $P = .27$). Members of District 10 (Alaska, Idaho, Montana,

Table 1. Athletic Trainers' Knowledge of Green Techniques by National Athletic Trainers' Association District

District (States)	Mean ± SD (95% Confidence Interval)	$F_{9,429}$ Value	*P* Value
1 (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont)	3.21 ± 0.51 (3.20, 3.51)		
2 (Delaware, New Jersey, New York, Pennsylvania)	3.18 ± 0.40 (3.08, 3.33)		
3 (District of Columbia, Maryland, North Carolina, South Carolina, Virginia, West Virginia)	3.23 ± 0.55 (3.05, 3.31)		
4 (Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin)	3.07 ± 0.59 (3.12, 3.33)		
5 (Iowa, Kansas, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota)	2.96 ± 0.66 (2.89, 3.26)		
6 (Arkansas, Texas)	3.12 ± 0.55 (2.67, 3.25)		
7 (Arizona, Colorado, New Mexico, Utah, Wyoming)	3.20 ± 0.54 (2.88, 3.36)		
8 (California, Hawaii, Nevada)	3.13 ± 0.50 (3.02, 3.38)		
9 (Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, Tennessee)	3.14 ± 0.50 (2.99, 3.26)		
10 (Alaska, Idaho, Montana, Oregon, Washington)	3.35 ± 0.43 (2.89, 3.39)		
Total	3.18 ± 0.53 (3.13, 3.23)	1.23	.27

Oregon, Washington) reported the highest level of knowledge (3.35 ± 0.43), and members of District 5 (Iowa, Kansas, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota) reported the lowest level (2.96 ± 0.66). The ATs' knowledge of green techniques is described in Table 1.

Perceptions of Waste

Of the 442 participants, 58.8% (n = 260) believed that the practice of athletic training produced a substantial amount of waste (Figure 1). Ninety-two percent (n = 408) of ATs admitted that they thought about the waste produced in their daily practice. However, many (n = 167, 37.8%) thought only *sometimes* about the waste. Just as many ATs thought *often* (n = 111, 25.1%) as thought *rarely* about the waste (n = 111, 25.1%).

The most frequently reported types of wastes produced by the practice of athletic training were plastics (n = 111, 29%), water (n = 88, 23%), and paper for administrative use (n = 81, 21%; Table 2, Figure 2). Fifty-three percent (n = 234) agreed that waste from clinical practice directly affected the environment. Forty-two percent (n = 186) of ATs believed they were fully aware of the environmental effects of their practice and were doing everything they could to reduce their footprint. Seventy-four percent (n = 329) reported they would like to use more environmentally conscientious techniques in their practice; however, only 38.1% (n = 168) felt well educated about environmental sustainability. Fifty-one percent (n = 226) of ATs considered themselves in a position to change practice to address sustainability. However, only 5.7% (n = 25) agreed that they researched health care facilities similar to their own to find ways of improving environmental sustainability.

The sentiment of a large amount of waste produced by the practice of athletic training was reinforced in the qualitative aspect of the study. When asked about the waste in athletic training, 1 participant offered:

> I think it's sad the amount of waste that we use. . . I'm at a small [National Association of Intercollegiate Athletics] school, and we go through 200 cases of tape every year. We go through 10 to 20 cases of Flexi-Wrap every year. We go through massive amounts of towels. . . We spend tens of thousands of dollars on supplies every single year and three-fourths of them go right into the trash.

Although the views of the interview participants aligned with those of the survey participants on the amount of waste, the types of waste cited most often differed. The survey participants listed plastics, water, and paper for administrative use as the most concerning, whereas the focus-group participants mainly discussed cups, tape, and water:

> . . . [Paper cups] are pretty popular to use. Gatorade puts out their tray that holds the cups on the top, and that's all good as well, but then usually those are used once and never used again, and they're just thrown [out].

Cups were a significant concern of participants, but athletic tape and plastic items were also consistently cited:

> The tape and the plastic is probably the worst. We go through 25–50 rolls of tape every single day. The cores are just pieces of cardboard, and nobody throws them into the recycling bin. If my [athletic] training room goes through 50 rolls a day to tape our football player[s] and then you compound that by all of the D[ivision] 3 schools, all of the [National Association of Intercollegiate Athletics] schools, all of the D2 schools, and all of the D1 AA and D1 schools, it's astronomical. It's just unbelievable how much [tape], how many [tape] cores

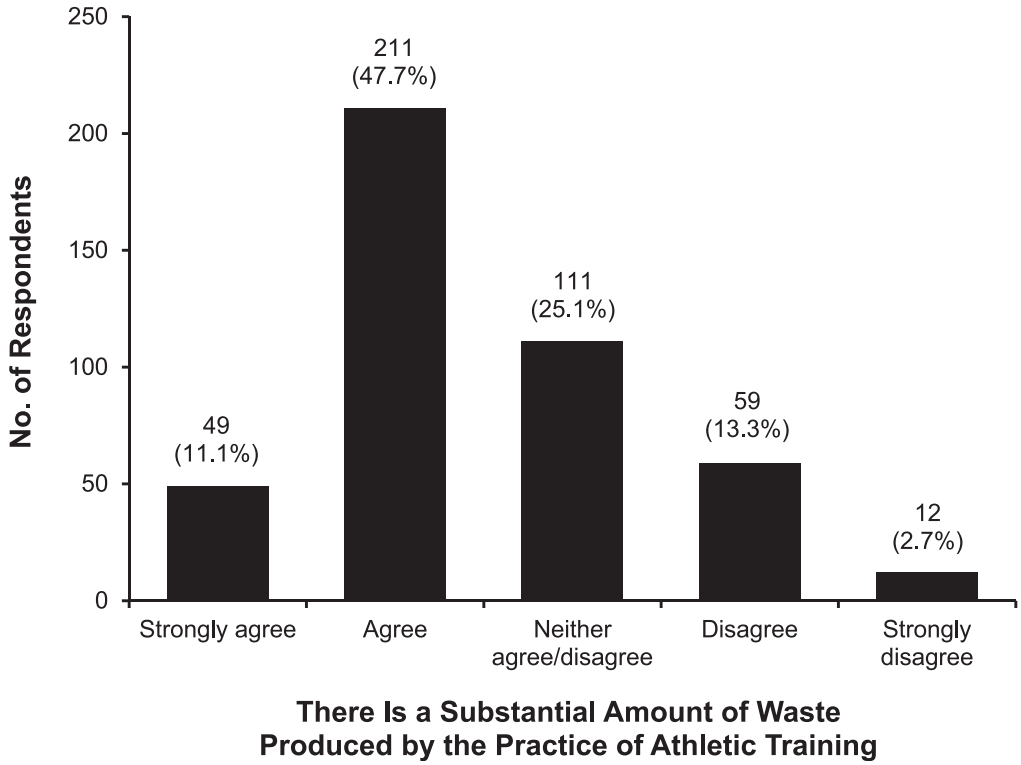

Figure 1. Amount of waste produced in athletic training practice (n = 442).

are out there being thrown away every day and taken to landfills.

Water waste was also a frequently noted concern among participants. For example, 1 interview participant stated, "I have 2 large whirlpool tanks that get filled daily and drained daily. They're used most of the time but not every day."

Specific Green Techniques

Some ATs were trying to combat the waste produced by their clinical practice. Specific green techniques included basic conservation efforts (recycle, reduce, reuse), using green purchasing practices (ie, buying in bulk, purchasing recycled goods), and assorted conservation techniques.

Conservation Efforts of Recycle, Reduce, and Reuse. ***Recycle.*** Eighty-one percent (n = 360) of respondents currently recycled at their place of employment. However, in 24.7% of those cases (n = 89), recycling was limited to paper. Other types of materials recycled are listed in Figure 3.

Although paper was the material recycled most often, some participants were making efforts to recycle as much as possible, as 1 focus-group participant illustrated: "I'm the one on the team bus that collects all the water bottles. You know [the other team members ask] 'What's she doing? I'm going to recycle these.'"

Confusion about what can be recycled was a factor:

> We've got a big bin that says aluminum cans, and we have a separate bin for tin. So you've got your aluminum right next to your tin. Some people perceive foil as being tin foil, not aluminum foil. . . I noticed that there's either foil either in the aluminum container, or there's foil in the tin container, and sometimes both.

Recycling was the most frequently cited conservation effort, but ATs were practicing other green techniques as well. These techniques included using green purchasing

Table 2. Waste Produced by Athletic Training Services (n [%])

	Scale[a]						
Material	7	6	5	4	3	2	1
Paper, administrative use (n = 381)	81 (21.3)	56 (14.7)	62 (16.3)	85 (22.3)	57 (15.0)	24 (6.3)	16 (4.2)
Paper, nonadminstrative use (n = 388)	56 (14.4)	102 (26.3)	111 (28.6)	50 (12.9)	52 (13.4)	14 (3.6)	3 (0.8)
Cardboard (n = 381)	45 (11.8)	88 (23.1)	82 (21.5)	88 (23.1)	63 (16.5)	11 (2.9)	4 (1.0)
Plastics (n = 411)	110 (26.8)	85 (20.7)	69 (16.8)	83 (20.2)	52 (12.7)	9 (2.2)	3 (0.7)
Aluminum (n = 365)	1 (0.3)	5 (1.4)	8 (2.2)	20 (5.5)	56 (15.3)	185 (50.7)	90 (24.7)
Glass (n = 408)	3 (0.7)	8 (2.0)	10 (2.5)	7 (1.7)	15 (3.7)	128 (31.4)	237 (58.1)
Water (n = 427)	88 (20.6)	53 (12.4)	61 (14.3)	60 (14.1)	93 (21.8)	23 (5.4)	49 (11.5)

[a] Scale ranged from 7 (*most*) to 1 (*least*).

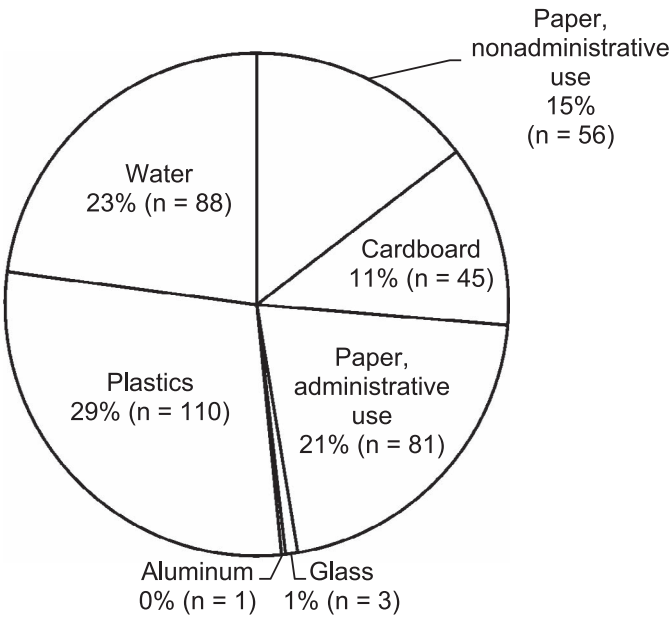

Figure 2. Materials listed as responsible for the greatest amount of waste produced in athletic training practice (n = 384). The total number is based on the sum total of votes given to *most amount of waste* in each category.

practices, reducing the amount of materials purchased, and reusing materials when possible.

Reduce. One technique used to reduce waste was to avoid overbuying products (ie, not using products before their expiration date). A way to accomplish this was to purchase products on an as-needed basis. Ninety-four percent (n = 409) of ATs based their order on their current inventory, and 81.5% (n = 353) ordered supplies on an as-needed basis. Products should be purchased in bulk when possible to avoid multiple shipments, thereby reducing emissions related to shipping. Two-thirds of participants (n = 289, 66.9%) ordered supplies in bulk only once per year.

Regarding the shipping for those supplies, each participant selected an option from a 5-point Likert scale (1 = *not at all representative*, 5 = *very representative*). A total of (n = 230) did not consider how their order was delivered. Forty-eight percent (n = 208) wanted their supplies shipped as fast as possible, even if multiple shipments were required, whereas 73.5% (n = 317) preferred a bulk shipment, even if it took longer to arrive. Eighty percent (n = 349) liked to order supplies from only 1 company, given products of equal quality and price. Using an independent *t* test, we found a difference ($t_{433} = 2.28$, $P < .001$) between the mean knowledge score and whether the clinician preferred to order supplies from only 1 company, given products of equal quality and price. Those who had greater knowledge of green techniques (3.88 ± 1.23) were more likely to prefer to purchase supplies from only 1 company than those who had an average level of knowledge (3.58 ± 1.40). Ordering from 1 company helps to reduce packaging and transportation of supplies. An interview participant reinforced the value of asking for bulk shipping:

> We try to ship quite a few things together, like Gatorade. We try to contact all the teams and see if we can go together and get a whole pallet shipped and other big things shipped at the same time (1) because it's less packaging, and then (2) because it's much easier manpower wise to get all that done at 1 time versus constantly having to be on the lookout [for shipments to arrive].

As for reducing shipping, a focus-group participant who worked at a secondary school stated that ATs in her district consolidated their ordering. This consolidation not only reduced shipping but it also saved them money: "I pool with other ATs in my area and ask where they are ordering from. Then we'll get our best prices. We confer and pool

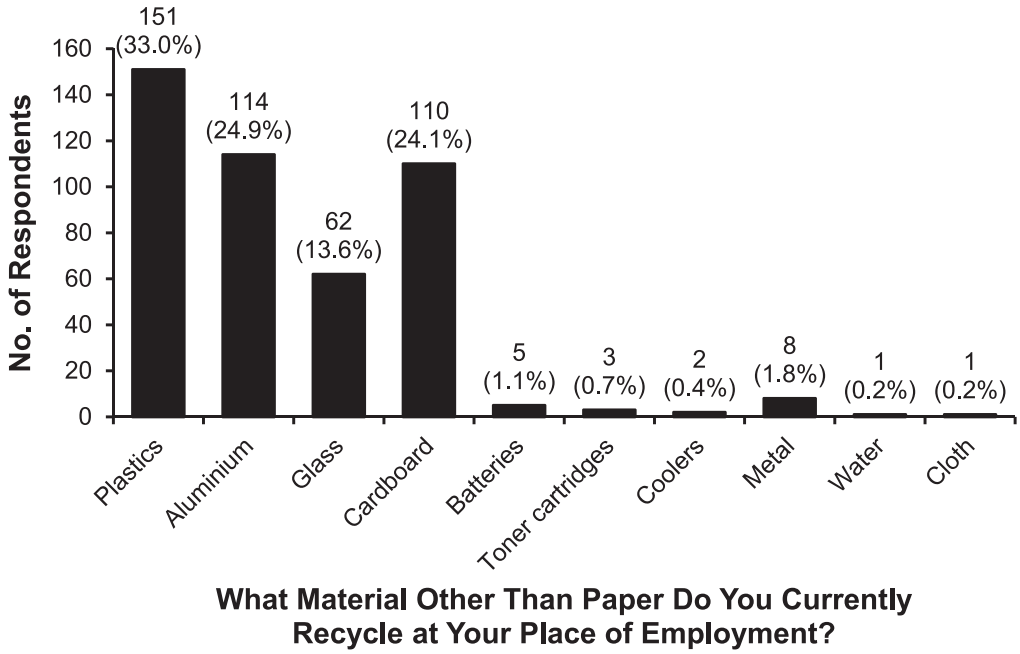

Figure 3. Other materials recycled (n = 457). Participants could choose more than 1 response.

together our order from 1 company so it all ships to 1 place."

This consolidation also helped to reduce waste:

> We're trying to get away from the paper cups as much as possible, especially if we're covering a gymnasium sport. So our volleyball or basketball [teams], instead of providing cups on the benches, we try and use more water bottles.

For the outdoor venues, a participant commented, "We've gotten to less cups there as well. We try to use water sources like the water boy; we still use cups, but we're trying to limit the paper products as much as possible."

Reuse. In many cases, ATs already thought of themselves as "green." One of the commonly cited reasons was the ability to reuse items. Crutches, elastic bandages, and electrodes were all frequently reused items. A focus-group participant reinforced the reuse of durable medical goods:

> We do use quite a few of the braces and sleeves over again. It's not something that is just checked out to 1 person, and then we never see it again. We do use those over quite a bit and just wash them, and I would check them back out to the same person or someone different.

Athletic trainers also repurposed items. For instance, 1 focus-group participant remarked:

> I think this pretty typical; a lot of ATs use the end of the tape rolls to make a heel lift for the hip Spica. I've seen that everywhere we go. We put all the rolls together instead of standing on a roll of tape and smashing the tape.

Another focus-group participant noted that tape rolls could also be repurposed into items for physical rehabilitation:

> The other thing, I'm guessing a lot of other people do this, is that we use those ends for other things like rehab, [for example], in foot rehab for strengthening the foot muscles, just having them pick them up [with their toes]. . . We dump a box full of tape ends onto the floor, and they have to pick them up with their toes and put them all back in, and then we dump them out again.

Many participants believed that overall, the profession was one of the lesser offenders when it came to waste in health care. One focus-group member observed, "We as [ATs] already do these things. We're already looking to save money," while another added, "We already do it. We just don't have a label." An interview participant echoed these sentiments: "As far as athletic training being a very wasteful profession, I think overall we aren't. . . a lot of stuff we do is hands on, whether it's rehab or [injury] prevention."

A focus-group participant who worked at a college with a strong commitment to environmental sustainability commented that his athletes helped find ways to reuse and repurpose items:

> We tie our knots real loose in our plastic bags because my athletes want to use them 4 or 5 times...We're using Mason jars [instead of paper cups], and then when we clean [them]. . . and they're going to make a little poster, an educational poster, of why we don't use paper cups at our college because. . . they're going to do a little research on how long it takes a paper cup to decompose.

An AT in a different focus group reported his students also helped to identify ways for his practice to become more environmentally sound:

> Prior to this, we would empty the water after every football practice. We would try and find a tree to pour the water on or on the field, if needed, but there was an athletic training student that was working with me at football, and the cooler had 8 gallons in it, and we were about ready to pour it out, and she's asked why we don't just save the water for tomorrow. "It's just water. It's not going to go bad. That's bad for the environment." So that was 2 years ago. Ever since, we've been saving our water or consolidating our water.

Reducing waste by reusing and repurposing items seems to be compatible with the athletic training profession. Athletic trainers can learn ways to further reduce waste from each other and from students.

Other Green Techniques. Section 4 of the ATEIS inquires about green institutional practices, including purchasing methods, the proper disposal of medications, and the efficient use of lights and water.

Purchasing Methods. More than one-quarter (28.9%, n = 127) of ATs tried to purchase recycled or recyclable materials for their place of employment, whereas 65.5% sought such materials for their homes (Figure 4). Those with a higher level of knowledge chose to purchase more recycled or recyclable products at home (1.85 ± 0.77) than those with a lower level of knowledge (1.33 ± 0.65; $t_{439} = -7.392$, $P = .001$).

Disposal of Medication. Pharmaceutical agents are considered hazardous chemical waste, which necessitates careful disposal. When asked about the disposal of medications, only 14% of respondents selected a green method; 13% (n = 56) used government takeback programs, and 1% (n = 5) combined medications with an undesirable material (eg, kitty litter) before placing them in regular trash (Figure 5). Significant interactions were found between green knowledge and medication disposal ($\chi^2_1 = 7.62$, $P = .006$) and between those with a lower level of knowledge and various methods of medication disposal ($\chi^2_1 = 3.97$, $P = .04$). Those with a lower level of knowledge of green techniques were more likely to report they did not know how expired medication was disposed of at their health care facility. Also noted was that 16.2% (n = 72) of participants did not stock medication at their place of employment.

Use of Lights and Water. A total of 37.9% of respondents (n = 165) reported that 50% or more of their lighting was energy efficient (ie, solar, automatic timers, motion sensors) at their main health care facility. However, only 12.8% (n = 56) noted that 50% or more of their water sources used low-pressure or controllable flow (eg, foot-pedal, sensor) regulators. The most common disposal

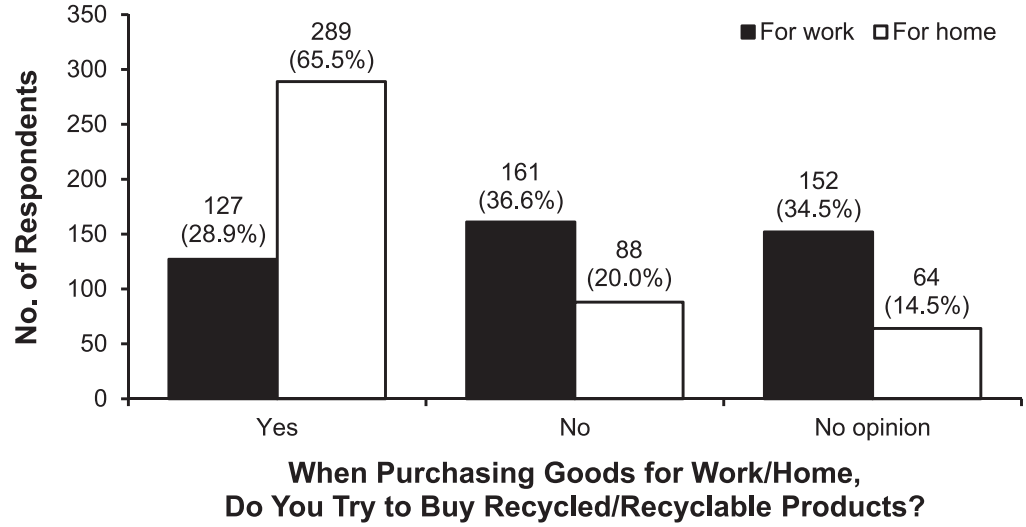

Figure 4. Individual recycling habits (n = 440 work[a], n = 441 home[b]). [a] Two participants elected not to answer this question. [b] One participant elected not to answer this question.

method for unused water at the end of games or practices was to throw it out (n = 230, 52.0%), whereas 34.6% (n = 183) chose the greener option of purposefully distributing it near trees, plants, or grass, and 14.5% (n = 64) saved it for the next day.

One focus-group participant shared, "In my practice, I bought 2 motion-detector lights because I'm notorious for forgetting to turn the lights out, or I'll try to get out and wonder if I left the lights on." Typically, participants reported these changes occurred at the institutional level. One interview participant commented that his institution asked a local energy company to conduct an audit of their campus. As part of this audit, the energy company suggested the following ways the athletic department, including the athletic training staff, could reduce their waste:

> All of our faucets are water-saving faucets, and any of the paper towels and paper bins that we use in the athletic training room are all recycled. . . The lights were [also] changed. . . we used to have the 1 [paper-towel dispenser] where the athletes could basically roll out as much as they want, and now each 1 comes out individually. . . I mean, there's a pretty significant investment upfront, but down the road, the cost savings should be pretty significant as well.

These results indicated that some ATs were thinking about the environment and attempting to alter selected aspects of their clinical practice.

Leadership

A total of 28% (n = 124) of participants indicated their institution specifically dedicated leadership to the practice of environmental sustainability. Twenty-five percent (n = 109) reported no such leadership, and 47.3% (n = 209) did not know if leadership existed. Of those who reported their place of employment had a formal committee to identify and implement environmental sustainability efforts, only 1.8% (n = 8) of participants were on the committee.

Eleven percent (n = 46) of respondents stated they, or a fellow coworker, initiated an environmental sustainability project at their place of employment. Athletic training staff (n = 18, 43.9%) most frequently initiated the project. A 1-way analysis of variance was used to compare knowledge of green techniques with the initiation of an environmental sustainability project. Those with greater knowledge of green techniques (1.86 ± 0.32) initiated environmental sustainability projects more often than those with less knowledge (1.96 ± 0.21; $F_{4290} = -2.88$, $P > .001$).

Institutional leadership was often cited as an important factor in whether employees sought green techniques within their own roles. One participant described the influence of a new building on campus on behavior:

> At the college I work at, they just built a new facility, a recreation center. It's a green building, and they're really pushing that on campus right now with this new building. They're really trying to make everyone more

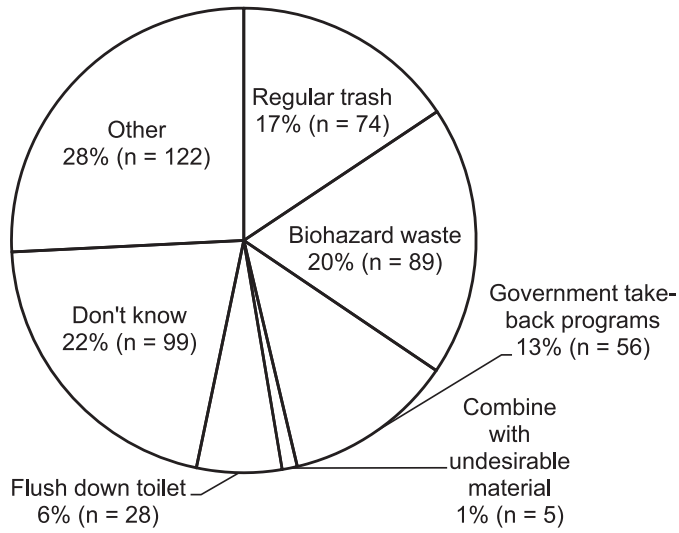

Figure 5. Medication disposal methods (n = 442). Participants could choose more than 1 response.

aware of how to do things and try to change the ways that we practice as ATs. It's difficult, and I'm not sure how to do a lot of it. . . with the resources that we have and the resources that we use, it's a little bit challenging.

DISCUSSION

Medical facilities are one of the biggest contributors of waste in the world.[9] This waste contributes to the degradation of the environment and, in turn, the health of its population.[6,9,10] Types of medical waste include solid waste (eg, trash, garbage), biohazard waste (eg, "sharps," human products), and hazardous chemical waste (eg, pharmaceuticals, disinfectants).[5] Each type of waste necessitates special consideration for management. The US Environmental Protection Agency developed a waste-management hierarchy to guide the disposal of nonhazardous materials.[11] The preferred method for managing nonhazardous solid waste is to reduce the amount of waste produced. When this is not feasible, waste should be reused, recycled, or composted, as applicable. The least desirable method of waste management is the treatment of waste (eg, shredding, incineration) or disposal of waste in landfills. Disposal of solid waste in a landfill is least desirable due to the associated contamination of the soil, ground water, and aquifers.[12] In addition, organic solid waste releases methane gas as it decomposes and is associated with global warming. Biohazardous and chemical wastes are subject to more regulations than solid waste due to their greater potential for harm. The improper management of biohazardous waste can pose a health risk to the public and waste workers. Therefore, special precautions are necessary for the disposal of biohazardous waste. Before 1997, more than 90% of biohazardous waste was incinerated.[13] In 1997, the Environmental Protection Agency set regulations for the incineration of medical waste due to air-quality concerns. Today, alternatives to incineration of biohazardous waste include thermal treatment and steam sterilization. These methods render the material noninfectious and eligible for disposal as a solid waste. Finally, the appropriate disposal of chemical wastes is necessary to avoid contamination of water sources such as lakes and streams and varies with the properties of the chemicals involved (ie, ignitability, corrosivity, reactivity, and toxicity).[14] Some chemicals require strict reporting, record keeping, and testing requirements for safekeeping and disposal, whereas others require disposal based only on federal and state regulations.

Participants in this study most frequently reported solid waste as the most concerning byproduct of the practice of athletic training. This waste varies from the infectious materials and biohazardous agents typically cited in other health care professions.[15] Due to the unique nature of athletic training, its effect on the environment may be different than that of other health care professions and is an area for future research. Biohazardous and hazardous chemical wastes were rarely discussed by participants. Although the practice of athletic training may produce less of these types of waste, more awareness of the various types of medical waste generated may be needed.

Despite the varied types of waste and uncertain practices, we should look to our colleagues in other health care professions for direction on how they are attempting to reduce or eliminate the byproducts of their clinical practices. In 2014, the Health Care Improvement Foundation published a "Compendium of Best Practices" reported by the Green Hospital Pilot Project.[16] Several of these reports included strategies to reduce waste similar to those addressed by participants in this study. They involve the handling of plastics, wood fibers, water, and paper for administrative purposes and the disposal of medications.

Plastics/Wood Fibers

Plastics from cups and beverage containers as well as wood fibers, such as cardboard, associated with the packaging of athletic training medical supplies, were identified as common wastes produced in the practice setting. Some health care professions have recommended that plastic devices be used sparingly.[17] However, these materials are recyclable; therefore, the key to reducing plastic waste may be to make recycling an efficient process.[18] For instance, the Children's Hospital of Philadelphia found that the recycling behavior of employees increased when trashcans were removed from individual workstations and replaced by waste-sorting stations located in common areas. The waste-sorting stations included a comingled bin for glass, plastics, and aluminum cans as well as separate bins for recycling paper and disposal of landfill waste (written communication, Health Care Improvement Foundation, 2016). Comingling recyclables was associated with increased household recycling behavior.[19] Therefore, ATs should consider installing waste-sorting stations in a central location within the athletic training clinic to increase the recycling of commonly used items such as ice bags, plastic wrap, cups, tape cores, and cardboard boxes.

Water

Water conservation is a critical concern in many parts of the United States.[20] Although some participants gave conscious thought to how the water was disposed of at their site, it is clear that more work is needed to curtail water waste. Current green practices to conserve water in health care include the use of water-flow regulators, recirculation of excess product water, and reuse of water after purification by reverse osmosis.[21] Athletic training is one of the few health care professions that prepares large quantities of water for the purpose of hydration. In other health care professions, hydration is provided on an individualized basis (eg, pitcher and cup) or as intravenous fluid. Therefore, no published recommendations are available for sustainably providing water for the purpose of hydration, making this an area for future research. Athletic trainers should evaluate their water-distribution techniques to determine ways to decrease waste. Commercially available hydration systems allow for the on-demand distribution of water and help to decrease reliance on water coolers and bottles. However, one drawback to hydration systems is that they are designed primarily for outdoor use. To reduce hydration-related waste during indoor activities, ATs should look at their current practices and make appropriate modifications for the setting: for example, replacing paper cups with reusable water bottles or glass jars, recycling paper cups and plastic bottles as appropriate and saving water at the end of an event for future use. When saving water for future use is unfeasible, ATs should

consider thoughtfully distributing water near trees, plants, or grass or speaking to their facility manager about installing rain barrels for gray water.

Paper for Administrative Purposes

Participants identified a great deal of waste produced by administrative processes such as printing injury reports, medical records, and daily treatment logs and shredding medical files as necessary. Alternative efficient and effective ways are available to manage records. The use of electronic medical records is associated with better clinical decision making, improved efficiency in health care delivery, and enhanced privacy and security for the patient.[22] Electronic health records (EHRs) are an evolution of electronic medical records and are designed to track patients' medical records and general health status and enable communication with other health care providers. The use of an EHR system is not only best practice, but meaningful use of an EHR is required for private and public health care providers to remain eligible for Medicare and Medicaid reimbursement.[23] Athletic Training System (www.athletictrainersystem.com; Keffer Development Services, LLC, Grove City, PA) is an example of an EHR that is compliant with governmental regulations for meaningful use.[24] Although a cost is involved, the use of an EHR should reduce the reliance on paper for administrative use due to its more powerful features. If the cost of purchasing an EHR is a prohibiting factor, ATs should research free general-use EHR software, such as Practice Fusion (www.practicefusion.com; San Francisco, CA).

Disposal of Medications

Although pharmaceutical products were not one of the most concerning types of waste in the practice of athletic training, our results identified some level of concern regarding their disposal. Forty percent of those surveyed disposed of expired medications in an unsustainable way (ie, flush down toilet, place with biohazardous materials), and 21% surveyed did not know how expired medications were disposed of. This is similar to the findings of a 2014 study[25] in which 37% of pharmacists surveyed were unsure how pharmaceutical distributors disposed of medications. Returning expired medications to drug distributors was the most common route of disposal for pharmacists. In addition, 98% of participants in this survey reported *never* when asked how often patients sought advice regarding the proper disposal of unused medication.

Some medications include specific instructions for disposal on their label. Therefore, one should always read the label carefully before disposing of a medication. Medication should only be flushed down the toilet if the information on the label specifically gives this instruction. Otherwise, the Food and Drug Administration provides guidelines for the proper disposal of unused medications for consumers.[26] Government takeback programs are the best way to dispose of medications, but these programs are limited. Therefore, the Food and Drug Administration published recommendations for the disposal of medications when take-back programs are not an option.[26] Medications in solid form should be removed from their original containers and mixed with an undesirable substance, such as kitty litter, dirt, or coffee grounds; placed in a sealed bag or can; and placed in the trash. Liquid medications can be mixed with flour, salt, or a nontoxic powdered spice (ie, turmeric, cumin), and the lid of the bottle should be taped shut before being disposed of in the trash. Medications in blister packs should be wrapped in multiple layers of tape and placed inside a sealed container. Finally, many inhalers can be recycled. These practices can be adapted for use by health care practitioners who typically handle a small amount of medications. However, an industry-wide protocol should be established to determine the best option for medication disposal by those health care workers who handle small amounts of substances.

The health care professions are one of the largest producers of waste.[9] For health care to become more sustainable, all health professionals should work together to find common solutions.[15] In this study, ATs identified plastics, wood fibers, water, and paper for administrative use as the most concerning types of wastes produced by the practice of athletic training. However, our findings also suggest the need for more education on topics related to environmental sustainability for practitioners. More research is required to determine the amount of waste actually produced by the profession as well as the best way to raise awareness of environmental sustainability in athletic training.

LIMITATIONS

We depended on self-reporting, which can be unreliable. Some participants may have perceived more knowledge of green techniques than they actually possessed, and this may have skewed the results. For example, those who reported greater knowledge of green techniques were more likely to place expired medications with the biohazardous waste. However, this action is not an accepted green technique. Therefore, participants may not be appropriately assessing their knowledge of green techniques. Additional education is needed to dispel common misconceptions regarding their use.

The internal consistency of sections 2 and 3 of the survey instrument was lower than desired. The Cronbach α was .602 ($n = 7$) for section 2 and .609 ($n = 8$) for section 3. The low number of questions in each section may have resulted in an underestimate of the level of reliability.[27] In addition, 1 question in each section was reverse scored to reduce response bias, yet reverse-scored items may also negatively affect the level of reliability.[27]

Our study also evaluated the perceived waste created by the practice of athletic training. This amount of waste varies depending on the practice size and setting. Not every practice setting was represented in the qualitative portion of the study. Thus, the generalizability of these findings may be limited. For a more accurate representation, direct measures of waste should be evaluated by future researchers.

Finally, focus groups were the preferred method of data collection for this study. This is because participants with limited knowledge of a subject may be hesitant to speak openly. However, logistical hardships prevented the organization of the number of focus groups needed to reach data saturation. Hence, we conducted 1-on-1 interviews to supplement the data from the focus groups. Therefore, the interview participants may not have shared as freely as they otherwise might have, which may be a limitation of this study.

CONCLUSIONS

The production of waste in a health care facility is an inevitable byproduct of professional practice.[28] Most ATs agreed that a large amount of waste was associated with the practice of athletic training. As do other health care professionals,[4] ATs can positively affect environmental health by conserving resources, changing their waste-management practices, and recycling. Specific practices include

- Reviewing current practices and policies in an effort to decrease unnecessary use of materials.
- Decreasing the reliance on plastic products as appropriate. Consider using nonplastic alternatives, such as elastic wraps as opposed to plastic wraps, and sustainable alternatives to plastic water bottles (mason jars, stainless steel bottles).
- Speaking to facility management to determine what recycling services are available and where to locate recycling stations to encourage maximum participation.
- Reviewing the materials used in the clinic as well as the amount of waste produced by clinical practice to determine which items can be reused, reduced, or recycled with an emphasis on reducing waste.
- Contacting local waste management facilities to determine what resources are available for properly disposal of pharmaceuticals, such as out-of-date over-the-counter medications.
- Conserving water by evaluating current water use and installing water-control devices to reduce waste. For hydration practices, consider investing in a commercially available hydration station and saving unused water for future needs.
- Consider implementing the use of EHRs to decrease the reliance on paper for administrative use.

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