National College Blue Ridge Marathon).³ The survey was completed during the onsite registration for the event. Participants were asked to provide demographic and travel information, and their best estimation of various costs.

Thirty-five teams of 3 persons registered for the event, and everyone was present at race start. There were 17 volunteers at the event including the race organizers, for a total of 122 participants. Eighty-nine surveys were completed (73% participation). Nearly two-thirds (62%) of participants were male. The average age of participants was 27 years (range 22 to 47). The majority of participants were students (56%), followed by residents (34%). The others were a mix of emergency medical service providers, attending physicians, and nurses.

The participants were asked about their level of income. Most (44%) were living on student loans. That was followed by 39% who had annual income levels between \$20K and \$60K. Only 6 participants claimed to have an income of more than \$80K annually. On average, participants traveled 4.5 hours one way to come to the event, and 52 (58%) spent at least 1 night away from home, with nearly all of those camping in the state park.

Participants spent an average of \$135 each (range \$20 to \$385) on travel, food, and equipment, independent of race entry fees and canoe rental. Equipment was, on average, the highest percentage of this cost. The registration cost was \$135 per team. Additionally, each team was required to rent a canoe at a cost of \$45. That brings the estimated total spent by a participant in this event to \$195 each. For the 105 competitors, that is an estimated total of \$20,475. Because volunteers were largely reimbursed for their expenses out of the race entry fees, they were not added to this total.

The amount spent on this event by each participant may be small compared with that spent on a more traditional conference with attendees staying in hotel rooms and eating at restaurants. Nevertheless, it does represent a substantial amount for the participants, considering that most of them were students or residents living on a budget. The race fee of \$45 per competitor (\$135 per team) is targeted to only cover race costs, which include land use, food for the race banquet, insurance, tee-shirts, and incidentals such as printing and equipment for the volunteers.

It is important to remember that a dollar spent in an economy actually translates into several dollars of total activity as some is spent, some saved, some taxed, and some exported. The spending multiplier formula is stated as: $1 / [1 - mpc * (1 - t) + mpm]$, where *mpc* is the marginal propensity to consume, *t* is the income tax rate, and *mpm* is the marginal propensity to import. A call to the local chamber of commerce placed the spending

multiplier between 1.8 and 2.5. That means that medical students, carpooling for half a day each way and camping while undertaking an adventure race, managed to generate between \$36,855 and \$51,187 of economic benefit to this Midwest region in a single weekend.

The response rate to our survey was quite good, and we consider our estimates of spending accurate. We have had many schools repeatedly send groups of teams to this event and conclude that they consider it worthwhile and of value. Event organizers should understand that students making spending decisions have significantly fewer resources than practicing physicians. Even though students' spending is more limited, a well-planned event for them can still create a significant economic impact on the community in which it is organized.

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Waterfall Mortality and Morbidity in North Carolina, 2001–2013

To the Editor:

Few locations like Western North Carolina have high concentrations of documented, easily accessible waterfalls and large numbers of visitors.¹ Because of these characteristics, waterfalls are popular places for outdoor recreation and play an important role in the state's tourism industry. Unfortunately, despite preventive measures by emergency management and resource managers, injuries and fatalities occur. This research analyzed the frequency of North Carolina waterfall injuries and fatalities over a 13-year period and identified the root cause of waterfall accidents.

Data were gathered by conducting an Internet search using a set of keyword phrases (eg, North Carolina waterfall accidents, North Carolina waterfall injuries, North Carolina waterfall deaths) for years 2001 to 2013. The content of each source was reviewed, and the following information was documented for analysis: year, month, and day of incident; waterfall name; sex and age of victim; and victim's place of residence. The root cause for each incident was also recorded. Root cause is the initial factor in the chain of events leading to an incident. For use in this study, 2 categories for root cause were used: unsafe acts and unsafe conditions. Unsafe acts relate to the actions, behaviors, and attitudes of the waterfall visitor. Unsafe conditions are hazards related to the waterfall environment that, if not addressed, can result in an incident. Data were collated and coded, and then analyzed using Microsoft Excel for Mac, version 14.0.0 (Microsoft, Redmond, WA).

Between the years 2001 and 2013, 39 cases, or an average of 3.0 incidents per year, were recorded. Reported incidents involved 42 victims at 27 different waterfalls. Eighty-three percent of victims were male. More than half (54%) of the victims were between the ages of 19 and 29 years (mean 27 years). Twenty-eight incidents (66%) resulted in a fatality (mean 2.1 deaths per year). Content analysis identified the place of residence for 34 of the 42 victims and found more than half ($n = 22$; 69%) lived outside the region. More than half (59%) of the incidents occurred during the years 2010 to 2013. Seasonal distribution showed incidents peaked during the summer months of June, July, and August (62%), followed by spring (23%), and were equally distributed between weekdays (46%) and weekends (51%).

Eight of 10 victims (81%) fell from the waterfall, and 62% of these falls resulted in a fatality. Drowning accounted for 18% of all fatalities reported. The primary unsafe condition leading to injury or death (66%) involved victims losing their footing on slippery, wet rock or trail. Unsafe acts leading to injury or death usually involved an activity above the waterfall (eg, wading, swimming) and made up 15% of incidents and 21% of fatalities. Jumping into or swimming in a plunge pool produced 12% of victims and 11% of fatalities. Ignoring a safety barrier was a factor in death or injury to 12% of victims. Engaging in photography (ie, getting in a better position for a photograph) accounted for 7% of incidents. "Would-be rescuers" and "reaching for a dropped object" made up a small percentage (5%) of the unsafe acts recorded. Alcohol or drugs may have played a role in 5% of fatalities.

The 2 primary risk groups identified in this study were males and young adults aged 19 to 29 years. This finding is similar to the morbidity and mortality statistics noted for other outdoor recreation activities and may be

explained by higher risk acceptance of males.² Research also noted that men 22 to 40 years of age fall from heights at a higher rate than women.³

Data also revealed that more than half of North Carolina victims lived outside the region. Previous research suggested tourists are involved in accidents because they are unfamiliar with their surroundings, are of a holiday mindset, and are more willing to take risks.⁴ The high number of waterfall accidents may also be related to the large number of easily accessible waterfalls throughout western North Carolina. These factors, coupled with inexperienced visitors unfamiliar with the dangers associated with waterfall environments, can lead to the unexpected consequences identified in this study.

The root cause for falling from a waterfall is rarely a single unsafe act or condition, but more often a combination of the two. Most falls from waterfalls happen when victims lose their footing by slipping on wet or algae-covered rock. Waterfall visitors can mitigate the possibility of slipping by being more aware of slippery surfaces and wearing appropriate footwear. Drowning was also associated with waterfall incidents, occurring exclusively in the plunge pools formed by hydraulic erosion at the base of waterfalls that make great "swimming holes." Swimmers new to an area should observe or talk to local residents or officials who are familiar with the site or should reconnoiter the area above and below the plunge pool for hidden dangers. A small number of visitors ignore safety barriers. Similar behavior was reported by Heggie and Heggie,⁵ who noted that many tourists hiked beyond posted warning signs near active lava flows, exposing themselves to dangerous conditions. Barriers are erected to protect the public from harm. Many waterfalls in North Carolina do not have safety barriers, however, because of their location.

Despite safety information, warning signs, and barriers designed to protect the public, falls from a waterfall can result in serious, often fatal accidents. Both direct and indirect management approaches—including posted warning signs; working with landowners, resource managers, and local businesses near waterfalls; providing online access to information about stream flow (with instructions how to use the information to prevent injuries); developing a public awareness campaign; and enhanced monitoring—could be implemented to make visitors more aware of the risks involved with recreation around waterfalls. Preventive efforts focused on males and adults aged 19 to 29 years that address issues of judgment, preparation, and experience should also be considered. Future research should incorporate observations at various waterfalls to document visitor behavior and how it contributes to waterfall accidents. Investigations into the types and severity of injuries sustained by

waterfall victims will also enhance the knowledge base for waterfall education.

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Flying for CME—A Big Carbon Footprint

To the Editor:

Global climate change is humanity's greatest challenge of the 21st century. Its impact on the environment is well known but it will also have impacts on public health—two of the pillars of the Wilderness Medicine Society (WMS). Recently, the WMS hosted a conference on environmental change and human health to review these issues.

This conference spurred much debate, including this ironic question: Why are we traveling thousands of miles and creating an enormous collective carbon footprint to talk about how we are going to reduce our carbon footprint? To provide some data on the impact from this small conference, I have estimated the total carbon footprint of the 50 attendees. Originating zip codes from the attendees were collected, and carbon emissions were estimated from those, using previously described methods.^{1–3}

The total CO₂ emission for the conference is 1.76 tons CO₂ equivalent per person, or 88 tons CO₂ equivalent total for this small conference. That is approximately equal to the total annual CO₂ emissions of 4 US citizens, or of 100 Bangladeshi citizens—where the impact of climate change will be much greater than in the United States. The total of all physicians' continuing medical

education (CME) air travel would generate much, much greater impact. And yet, this still represents just a small portion of all healthcare-related emissions, which total 8% of US CO₂ emissions.⁴

As medical professionals, we are uniquely positioned to make an argument on climate change from the perspective of global health. We can expect an increase in morbidity and mortality from effects of famine and dehydration, extreme weather events, tropical disease redistribution, heat illness, and asthma, among others. The burden will be carried disproportionately by the poor and undeveloped nations as well as by the elderly and young, despite the fact that the richest are responsible for most of the emissions.

Our window of opportunity is closing. We need to reevaluate what we are doing to our planet and to our health. Healthcare has a part to play in the dialogue, from changing our own practices to changing those of our patients. One part of this is reconsidering the need for travel, including to medical conferences.

There are many alternatives to traveling long distances for CME and conferences. Modern technology makes it possible to connect without travel through virtual teleconferences, e-mail, online chats, wikis, social media, and podcasts. These are new technologies, but as they mature and millennials enter medicine, I expect they will become more used and more useful. Alternatively, for the locavores and technophobes alike, there are many options for CME available in their local area that might benefit them even more than a national level conference by tailoring education and collaboration to regional issues.

On the contrary, it is difficult to put a value on national meetings. For instance, at the WMS environmental conference referenced here, we were able to pull together a collective of national and international minds that had a depth and breadth of expertise not found in most locales. There is something more human about in-person meetings, particularly the value of networking and serendipitous discoveries. And, of course, there are the perks of hosting conferences at desirable venues.

The ultimate question is one of ethics and values. Where do we draw the line of benefit and risk? The world is going to be experiencing climate change—that much is beyond debate to those who know it best. Are we going to change with it? Personally, I think the risk lies in inaction.

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