1.4 HOW TO USE PUBLIC EDUCATION TO CHANGE LIGHTNING SAFETY STANDARDS (AND SAVE LIVES AND INJURIES)

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1. INTRODUCTION

Lightning has been the second largest storm killer in the United States for the last thirty five years (López et al. 1993; Curran et al. 2000). However, compared to other parts of the world, the United States has only moderate lightning activity (Blakeslee et al. 1999; Christian 2003). One might predict that lightning injuries would be higher for populated areas with higher lightning activity, particularly if the population has other reasons for increased risk (Holle and López 2003).

In 1900 in the United States, there were substantially more deaths inside buildings than at the present. Because US housing was much less substantial than is now the situation, deaths often were caused as the building exploded or collapsed when hit by lightning. In addition, the more rurally distributed population had a higher risk than city dwellers (Holle et al. 2003). It was shown by López and Holle (1998) that US lightning deaths have decreased from 6 per million earlier in the last century to about 0.5 per million at the present time. This substantial decrease in deaths is due to a combination of factors including relocation of the majority of the population to urban areas, to industrialization of farming and other high exposure, labor-intensive occupations, and to modern housing. Such dwellings are relatively well grounded because of internal electrical wiring and plumbing, and are too substantial to be easily and precipitously destroyed. It is reasonable to conclude that areas with more lightning activity, large agrarian populations and less substantial and ungrounded housing would have at least the same fatality rate as the US rate in 1900 (Holle and López 2003).

Non-fatal injury statistics are less well reported than fatalities, but have been shown to average about ten times the number of deaths (Cherington et al. 1999). For countries in the densely populated tropics and subtropics, the death and injury rates have been projected to be at least 24,000 deaths and 240,000 injuries annually (Holle and López 2003). The total deaths and injuries from lightning in the world undoubtedly exceed this conservative estimate by Holle and López (2003).

In this paper, we report the effects of an aggressive media campaign that we have maintained in the United States since 1991 to educate the public about lightning injuries and how to avoid them. We will also outline the 'message' we deliver, resources that are available, how to form a collaborative interdisciplinary team and other steps that can be taken in any country to lessen deaths and injuries from lightning. This paper is based on the premises stated in Table I.

Table I. Premises for mobilizing lightning information to decrease personal injuries.

- Public education CAN MAKE A DIFFERENCE.
- There are relatively few centers where lightning is studied and small numbers of people study lightning at these centers.
- Although one individual can make a difference, an alliance with others can produce more results in a shorter period.
- Innovative connections can be formed between lightning specialists from several fields.
- Recent improvements in communications greatly advance such alliances.

2. UNITED STATES LIGHTNING SAFETY WORK AND RESULTS

Prior to the early 1990s, lightning safety and injury prevention was infrequently addressed or discussed. Authorities from various disciplines were called on by the press for interviews on the scientific aspects of lightning but little was known about injuries caused by lightning. Due to increasing knowledge of the demographics and medical aspects of lightning injury and the partnering of physicians with lightning scientists in the United States, briefings and documentaries on lightning began including medical aspects and safety as well.

There were attempts to standardize lightning safety recommendations such as those by Kitigawa et al. (1990) and Andrews et al. (1996). However, it was not until 1998 that the Lightning Safety Group, an ad hoc interdisciplinary group of lightning experts, met to agree upon lightning safety guidelines (Cooper et al. 1999; Holle et al. 1999; Zimmermann et al. 2002). The members of this group agreed to publish the guidelines in their individual specialty publications in order to obtain the broadest possible audience and application. Members of this interdisciplinary group have given countless interviews and worked as expert consultants for a myriad of media venues ranging from newspapers

to magazines, radio talk shows, television news programs, documentaries and television talk shows both at the local and national level. In addition, many speak to audiences ranging from school children to national safety, medical and meteorological meetings, have helped with student projects from primary to post graduate level, and edited lightning safety information for websites and publications that wished to incorporate these guidelines on lightning safety (Table II).

Several professional organizations have formally adopted the lightning safety guidelines and more recently have published position statements urging broadcast meteorologists to incorporate safety information in their broadcasts, especially the American Meteorological Society, National Weather Association, and the National Athletic Trainers Association. In 2001, the National Weather Service instituted Lightning Safety Awareness Week (LSAW). The LSAW planning committee has assembled a comprehensive website on lightning and lightning safety at www.lightningsafety.noaa.gov. This site includes special sections for the media, for teachers and for local National Weather Service personnel to equip them in their local and regional safety and education efforts, broadening the number of people who are equipped to encourage lightning safety. Many groups have asked to join the LSAW team as sponsors or partners (see website). Public service announcements and downloadable posters have used nationally recognized professional sports figures from golf, soccer and most recently baseball in attempts to reach young people, often the most vulnerable but also the most teachable population (Holle 2005).

Many of the groups and individuals have formed websites with information, publications and links to the web of specialists interested in lightning phenomena as well as injury prevention. E-mail has made working with others, whether professionals, students or the general public, easier and less expensive than former modes of communication.

Members of Lightning Strike and Electric Shock Survivors, International (LSESSI), a support group for lightning strike survivors and their families have worked with broadcasters, lightning experts and the media to produce documentaries and national broadcasts as well as more local stories of interest to their own communities, especially during Lightning Safety Awareness Week. This organization reaches out to newly injured people who are reported in media publications as well as those who have had the injury for many years.

Lightning safety guidelines are now included in the literature for coaches of many sports such as the NCAA (National Collegiate Athletic Association) through the summary by Bennett et al. (1998). Guidelines are also included in park managers' literature, and in recreation and backpackers' handbooks such as NOLS (National Outdoor Leadership School) as summarized by Gookin (2002), and the Wilderness Medicine Association (WMA). Lightning safety information has become a regular feature in the usual seasonal newspaper and magazine stories on sunburn, insects and other summer hazards.

Table II. A sample of groups for lightning presentations.

Scientific societies
Meteorologists
Medical groups
Broadcasters
Universities

Safety groups
Emergency managers
Safety seminars
Storm chasers / spotters
Industrial groups

Schools
Elementary schools
High schools
Curriculum planning
Science fairs, school projects
Meteorology classes

Construction industry
Building managers
Utilities, oil, and gas
Insurance

Lightning survivors

Sports and outdoor groups
Agriculture
Scouts and guides
Park managers
National Park Service

Military & government organizations
Aviation

Community organizations
Rotary, Civitan, 4-H
Churches
Community centers

Building on the study by López and Holle (1998), Lengyel of the University of Oklahoma recently completed a Master of Science study of lightning deaths using two independent data sources.(2005) She found that the steady decrease in deaths after 1959 had leveled off in the 1980s to what could be considered an 'irreducible baseline' level of injuries. Surprisingly, the reported fatalities started another downward slope beginning in 1991, which resulted in a 42% decrease in deaths compared to that predicted by the 1980s slope. While we cannot say that this decrease is wholly due to the safety education campaign, it may at least be a major contributing factor. This recent period also coincides with the deployment of the National Weather Service WSR-88D radar network, as well as greatly improved access to weather data by the public. Lengyel further analyzed the reported deaths and injuries in the 1990s to find that up to another 40% of deaths and injuries could have been prevented if the victims had followed the Lightning Safety Group's "30-30 rule". Therefore, there appears to be room for additional improvement with safety education in the US.

3. HIGH LIGHTNING RISK COUNTRIES

Table III shows that the highest area of lightning strike density in the United States ranks only fourteenth compared to other parts of the world.

Table III. Top 10 areas of lightning density in the world (Christian 2003).

Location	Flashes/km^2/yr From Optical Transient Detector
1. Kamembe, Rwanda	82.7
2. Boende, Democratic Republic of Congo	66.3
3. Lusambo,Democratic Republic of Congo	52.1
4. Kananga, Democratic Republic of Congo	50.3
5. Kuala Lumpur, Malaysia	48.3
6. Calabar, Nigeria	47.3
7. Franceville, Gabon	47.1
8. Posadas, Argentina	42.7
9. Ocana, Colombia	39.9
10. Concepcion, Paraguay	37.0
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14. Orlando-Tampa, Florida	35.4

Many high lightning risk regions of the world have not had the same demographic changes that helped lower the lightning casualty rate in the United States in the past century. A large number of people, particularly in tropical and subtropical regions with higher lightning risk, continue to rely on labor-intensive agriculture and live and work in dwellings with minimal grounding from such methods as electrical wiring and plumbing. Susceptibility to lightning injury in this area of 4 billion people can be assumed to be at least as high as it was in 1900 agrarian United States (6 per million) or about 24,000 deaths and 240,000 injuries per year (Holle and López 2003).

How many lightning casualties could be saved with innovative housing and grounding solutions and lightning safety information? The majority of the decrease in lightning injuries in the United States between 1900 and 1990 had little to do with lightning safety, and more to do with demographic changes which are not likely to happen in many parts of the world in the foreseeable future. Some populations may be more susceptible than others depending on housing characteristics, geography, weather and local crop patterns. Creative solutions may need to be applied to decrease the casualty rate in more agrarian and less developed areas. In addition to working in the open, some populations may have long-standing myths, superstitions, cultural habits, and/or religious beliefs that put them at greater risk or provide them with greater safety. Messages tailored to the most pressing threats may need to be balanced against those that are more easily and economically changed.

4. BUILDING A LIGHTNING SAFETY COALITION

Just as was the case two decades ago in the US, lightning specialists and those interested in saving lives in other countries may feel isolated and incapable of having much impact. However, individuals can make a difference, particularly if they are open to forming networks and coalitions with those who have similar concerns but different areas of expertise. Innovative and interdisciplinary alliances may address many aspects of lightning safety, exchange information and teach each other about their fields to increase knowledge of lightning injury patterns in their communities and succeed in lightning safety efforts. Recent improvements in communications can greatly facilitate such alliances. Table IV offers suggestions on how to spread information about lightning safety as well as to educate.

Table IV. Methods for spreading information on lightning safety.

1. Network - make multidisciplinary contacts outside standard approaches
2. Be *Flexible*, use available material
3. Share your expertise, be open to new opportunities
   - -Help any student with any project
   - -Answer e-mail, put up a website
   - -Speak to any group anywhere
   - -Work with the media, connect them to other lightning people
4. Persevere – don't listen to "naysayers"

Table V. Lightning – The perfect media story.

Media factors	Lightning aspect
Beauty:	Dramatic natural phenomenon
Science:	Unusual, new findings
Medicine:	Aspects of injury
Common:	Sports, work, recreation
Tragedy:	Death / injury
Hope:	Recovery and life after injury
Media:	Can make a difference
Public education:	Injury prevention

In some countries, lightning can be the perfect media story that incorporates science, the beauty of a common natural phenomenon, medical aspects, common recreational or work activities that can put people at risk, tragedy as people are injured, hope as recovery occurs, and the chance to educate the public and prevent injury (Table V). The main components of the message, and keys to delivering the message have been found to include the factors listed in Tables VI and VII.

Table VI. Main components of message that lightning injuries can be avoided.

1. Counter ubiquitous incorrect myths about lightning
2. Lightning safety is NOT convenient
3. Plan ahead to avoid dangerous situations
4. Avoid tall objects, water, and open areas
5. Use a method to measure the risk, such as the 30-30 rule
6. What a person wears or carries is not important
7. Substantial buildings and metal-topped vehicles are safe if a person is not in contact with the conducting path
8. More detailed rules and explanations are in Cooper et al. (1999), Holle et al. (1999), Zimmermann et al. (2002), and www.lightningsafety.noaa.gov, among others

Table VII. Keys to delivery of the message.

1. Give a clear message
2. Use humor
3. Allow time for questions
   - -Allows interaction
   - -Gives the opportunity for clarification or reinforcement
   - -Increases retention
   - -Gives the opportunity to add things you forgot
   - -Learn what you need to rephrase or explain differently
   - -Recruits good contacts and 'converts'
   - -Gives you great stories!
4. Give the audience something to take home
   - -Posters, pamphlets
   - -Magnets
   - -Tags for golf bags
   - -Promotional items from local merchants
   - -Grocery bags
   - -Materials to help them convince others
   - -NCAA guidelines
   - -LSESSI (support group) information

5. CONCLUSIONS

Each Individual can make a difference in the lives of others. Lives can be saved by education on the risks of lightning injury and how to avoid it. Nothing can guarantee lightning safety but risk can be minimized.

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