

A BRIEF HISTORY OF LIGHTNING SAFETY EFFORTS IN THE UNITED STATES

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ABSTRACT

Although several individuals in the United States (US) were working on lightning safety efforts, it was not until the early 1990's that researchers from many fields of study began to work together as they became aware of others with similar interests. The first organized effort on a national scale was in 1998 when a multidisciplinary group of recognized lightning researchers and experts met at an American Meteorological Society meeting and agreed on the Lightning Safety Guidelines (LSG) which were published in a number of venues.

Beginning in 2001, a Lightning Safety Awareness (LSA) campaign was initiated by the US National Oceanic and Atmospheric Administration with many of the LSG individuals as well as others.^{1,2} The LSA website (www.lightningsafety.noaa.gov) has become the premier lightning safety site with general information, up-to-date injury statistics, games, puzzles, public service announcements as well as special sections for the media, teachers, boaters, and many other interests and concerns. LSA members and others have continued to be active in promoting lightning injury prevention, have trained many others, and have continued to develop lightning safety themes such as 'When Thunder Roars, Go Indoors!' that can be learned by any age.

Collectively, the LSA team members and associates have made themselves available for thousands of interviews with newspapers, radio and television, worked on dozens of documentaries, as well as continuing their own research and publication. There has been a steady decrease in the lightning fatality rate over the past twenty years of work with a rate of 0.1/million US population in each of the last three years, in part due to the educational efforts of this

group and the media's support in disseminating lightning safety information.

Key Words: Lightning safety, injury prevention, lightning injury, lightning safety guidelines

1 INTRODUCTION

For over a century in the United States (US), lightning was the second largest storm killer, exceeded only by floods.³ In large part because of lightning safety educational efforts over the past twenty years, as of 2011, lightning slipped into the third spot. From an average of about 70-75 people killed every year, and at least ten times that many injured, the deaths have slipped to only 26 in the calendar year of 2011 – a decrease of nearly two thirds.²

2 HISTORY

No history of lightning safety would be complete without mentioning Nobu Kitigawa. (Figure 1). Over decades starting in the 70's, he and his associates Ishikawa and Ohashi, investigated many lightning injury cases, often took their theories to the lab to test out and then would use their findings to reapply to lightning injury prevention. Dr Kitigawa, now retired, has been a mentor and advisor to lightning researchers around the world.

Lightning Location and Protection, Inc. was incorporated in 1976 by Philip Krider and Martin Uman based on their research, measurement and theory on the electric and magnetic fields generated by lightning. (Figures 2,3) This technology began providing local lightning information in parts of the US in the early 1980s, then the US National Lightning Detection Network (NLDN) began providing uniform national information to researchers and operational users



Figure 1. Nobu Kitigawa with the Kitigawa International Medal of Keraunomedicine at ICOLSE 2003



Figure 3. Martin Uman

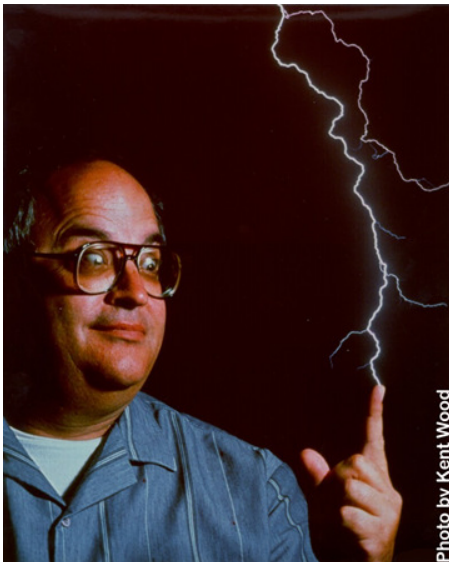


Figure 2. E. Philip Krider

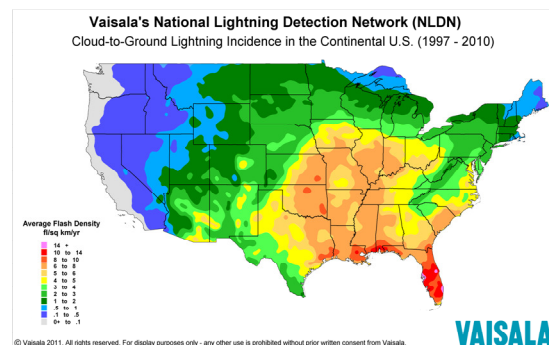


Figure 4. Annual US Flash density per square kilometer 1997-2010

at the start of 1989.⁴ (Figure 4) Since then, many other countries have implemented similar systems. With further advances in technology, global lightning mapping has begun and may be quite useful for lightning prediction, warnings and safety studies.

Prior to 1980, there was little published in the medical literature about lightning injuries. Cooper had begun her work in high voltage electrical injuries in the late 1970's while a resident in training in emergency medicine. (Figure 5) Someone asked her if lightning caused the same



Figure 5. Mary Ann Cooper

types of injuries. On reviewing the literature she found that it contained only isolated case reports and older general reviews, with almost no reports of long term problems suffered by survivors. The fatality rate had never even been calculated! Her 1980 paper was the first organized medical study of lightning injury.⁵



Figure 6. Ron Holle

Research meteorologists Ron Holle and Raúl Lopez began using localized lightning sensor data in Florida for meteorological purposes in the early 1980's but did not become involved in lightning safety until they investigated a case of two people killed on a beach in Florida using lightning data from the Kennedy Space Center system. (Figures 6,7) They expected to see thousands of flashes but found only two.⁶



Figure 7. Raúl Lopez

Michael Cherington, a physician, published his first paper on lightning injury in 1990 which caught the attention of Ron Holle and Raúl Lopez. They agreed to meet and shortly afterwards, Dr. Cherington, along with his partner,



Figure 8. Michael Cherington and Philip Yarnell

Dr Phil Yarnell, convinced their hospital to sponsor the Lightning Data Center (LDC) which began in February 1992. (Figure 8,9) The LDC is now chaired by Ken Langford, a professional photographer with a long interest in lightning. Members of LDC worked together to write and publish a paper entitled "The Underreporting of Lightning Injuries and Deaths in Colorado," published in the Bulletin of the American Meteorological Society (AMS) in November 1993.⁷ This paper is the basis for the commonly accepted 1:10 ratio of deaths to injuries.



Figure 9. Second meeting of the Lightning Data Center. Left to right: Michael Cherington, Raúl Lopez, Jerry Estep, Jodi Chambers, Debbi Clark, Ron Holle, Ken Langford, Steve Clark

In 1991, Ron Holle met Cooper when he came to Chicago for Ted Fugita's retirement party. They began a very fruitful collaboration.⁷

William Roeder, a meteorologist, started dealing with lightning when he began work at the Kennedy Space Center in 1994 but did not become involved in public lightning safety education until 1998 when the Lightning Safety Group (LSG) met at the American Meteorological Society meeting in Phoenix, Arizona. (Figure 10)



Figure 10. William Roeder

Brian Bennett, an athletic trainer, surveyed the lightning safety practices of US colleges, finding that few considered it a risk worth addressing. He and Katie Walsh worked with the National College Athletic Association to publish guidelines for coaches about delay or cancellation of practices and games.^{9,10} (Available at: http://www.ncaa.org/wps/wcm/connect/873cf8804e0db2a5ac9cfc1ad6fc8b25/SMH0708_final.pdf?MOD=AJPERES&CACHEID=873cf8804e0db2a5ac9cfc1ad6fc8b25)

2.1 Lightning Safety Group Recommendations

The Lightning Safety Group was an ad hoc meeting of lightning experts from many fields and included all of the aforementioned people as well as others from industry, academics, medicine, physics, insurance, meteorology, and research. Most had been doing lightning safety briefings, media interviews, and publications individually and many were professional colleagues. They realized that there were many old and untested myths about lightning that were often at odds for teaching safety.^{11,12} Because of new research on lightning strike distances and a desire to be consistent in all of our messages, the individuals believed it was important to meet to write a consensus statement of recommendations on lightning risk, safety and injury prevention.¹³ They met at the AMS meeting in 1998.

The recommendations formulated at this meeting included safety for individuals, for small groups with short evacuation time and for large

groups with longer evacuation times such as sports stadia or rock concert venues. They also included the parts of a lightning safety action plan and the '30-30 rule'. Recommendations noted that the only safer places for someone to go when lightning threatened was in a substantial building (containing indoor plumbing and wiring) or a fully enclosed metal vehicle. The Lightning Safety Guidelines (LSG) were published as widely as possible in the journals of the participants.^{14,15} In addition, they were shared with colleagues around the world for comment.

Position statements incorporating LSG were developed by the National Athletic Trainers Association and the American Meteorological Society.^{16,17}

2.2 National Lightning Safety Awareness Week (LSA)

By 1999, John Jensenius, a meteorologist with the National Weather Service in Maine came to the realization that one of the higher risk per capita lightning injury areas in the US was in New England. (Figure 11) He recruited Mr. Holle to do a series of lectures and interviews on lightning safety with him in the area for the first regional LSA Week. Mr. Jensenius subsequently submitted a proposal to the National Weather Service for a national campaign on lightning injury prevention using a national lightning safety awareness week.



Figure 11. John Jensenius

The first national LSA Week was held in June 2001. Many of the people who had been involved with the LSG were invited to participate in initial conference calls planning the week, writing and designing LSA website (www.lightningsafety.noaa.gov), and giving media

interviews at the time. The first LSA campaign was launched with a national press conference at a Professional Golf Association tournament with a professional golfer as the celebrity spokesperson, high government officials from the weather service, Jensenius, and Cooper.

Information packets for regional weather offices included talking points, posters of the celebrity spokespersons. (Figure 12 - all posters available for free download at www.lightningsafety.noaa.gov/posters/htm) and contact information for resource people. These materials have been added to and updated yearly and are all available for free download and distribution for lightning safety efforts.



Figure 12. First Annual Lightning Safety Awareness Week poster showing Rocco Mediate and giving the 'Lightning Kills, Play It Safe' message.

The Lightning Safety Awareness website (www.lightningsafety.noaa.gov) remains the best and most complete website on lightning safety in existence with links to all pertinent websites in this area. It is checked and updated several times per year. The LSA site contains up-to-date statistics on lightning fatalities (current year and previous years) and lightning strikes which are frequently used by the media.

2.3 Development of Lightning Safety Education, Slogans and Materials^{2,18}

The LSG recommendation of the '30-30 rule' was taught for many years because it was an easy to remember rule used to teach when to seek safe shelter (30 second count between the first lightning seen and the first thunder heard) and when it was safe to resume activity (30 minutes after the last thunder heard or lightning seen).

Early on, 'If you see it (lightning), flee it; if you hear it (thunder), clear it' was used as a catchy teaching slogan. In addition, there was a long list of actions to do or to avoid that was developed, taught, and distributed on posters and refrigerator magnets (Figure 13).

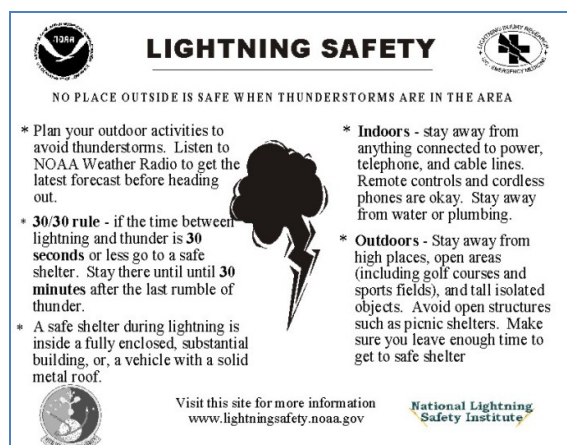


Figure 13. Early lightning safety refrigerator magnet

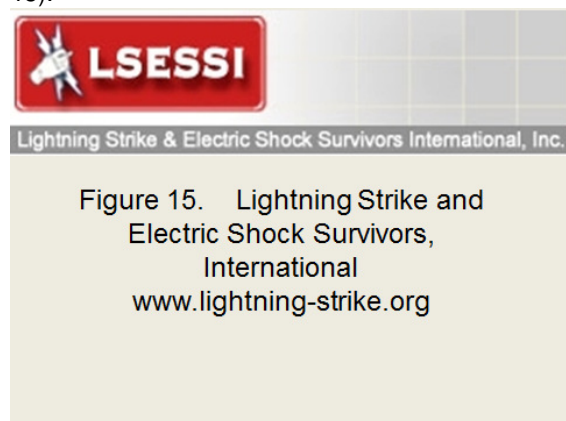
Over the last five years, all of these have been abandoned in favor of a much simpler message, 'When Thunder Roars, Go Indoors' which is simple enough for even a three or four year old child to remember when thunderstorms arise.(Figure 14)



Figure 14. Sticker and magnet currently being distributed for Lightning Safety Week, safety briefings, and schools.

Lightning Safety Awareness Week (LSA) is held the last full week of June every year. As a US government sponsored website, all materials appearing on the website are free for download and use by the public.

The LSA website contains information on lightning, lightning safety, medical aspects of lightning injury, and many other useful materials including sections for the media, teachers, and links to other safety sites not sponsored by the US government. There is also a link to the international support group for lightning survivors and their families (www.lightning-strike.org) (Figure 15).



The LSA site contains games and puzzles for children, lightning safety message posters for free download, stories from survivors, and even an interactive slide show called 'Leon, the Lightning Safety Lion'. This was designed initially for children but turned out to be equally effective and well-liked by adults (Figure 16 -- <http://www.nws.noaa.gov/os/lightning/kids.htm>).

In 'Leon', a series of slides show situations where lightning might occur and asks the viewer to select 'Safe' or 'Not Safe'. When the selection is made, either Leon applauds the viewer for their correct selection or is 'electrocuted' by the lightning and gives an explanation of why the choice was in error.

Every year, members of the core team for LSA week begin conference calls several months in advance to choose a focus for the year and discuss changes that need to be made in the website or the messages delivered. Based on research, committee members' experience at briefings, and other factors, many modifications and improvements have been made over the ten years since the LSA campaign began, all with the idea of providing a better resource on lightning safety and injury prevention for the public.

3 LESSONS LEARNED¹⁸

Lightning safety educators found that giving warnings to adults about lightning safety



Figure 16. Leon the Lightning Safety Lion Game.
<http://www.nws.noaa.gov/os/lightning/kids.htm>

had little impact, primarily because adults have a tendency to feel invulnerable and not at risk. LSA changed focus and began working with parents. When parents are told about the injuries and how it could affect their children, they are much more likely to change their behavior and that of their children. Efforts aimed directly at children are also very effective. Stickers and magnets with the 'When Thunder Roars, Go Indoors' message are often used in briefings.

When parents complained that their children's coaches were resistant to stopping games for lightning, they were referred to the NCAA coach guidelines available at [http://www.ncaa.org/wps/wcm/connect/873cf8804e0db2a5ac9cfc1ad6fc8b25/SMH0708_final.pdf?MOD=AJPERES&CACHEID=873cf8804e0db2a5ac9cfc1ad6fc8b25](http://www.ncaa.org/wps/wcm/connect/873cf8804e0db2a5ac9cfc1ad6fc8b25/SMH0708_final.pdf?MO D=AJPERES&CACHEID=873cf8804e0db2a5ac9cfc1ad6fc8b25). Parents could present their children's coaches with a print out and comment that, 'If professional coaches (who rely on practices and games won to keep their jobs) are worried about lightning, we as parents and coaches should be worried about our children's safety as well.' Now most volunteer and professional coaches and referees have become the biggest proponents of lightning safety on the playing field.

Lightning Safety Toolkits have been developed for multiple venues to address the original LSG recommendations on evacuation of larger venues with longer evacuation times.¹⁸

4 PUBLIC EDUCATION AND THE ROLE OF THE MEDIA

Over the past three decades, lightning experts have freely given their time for thousands of interviews to newspaper, radio and television reporters all over the world as well as participating in dozens of documentaries for the Discovery Channel, National Geographic and others. Every year, local offices of the National Weather Service actively engage the public in lightning safety week,

particularly in lightning prone areas. When possible, they recruit a local survivor of lightning injury or their family to tell their story in interviews and appearances.

The media discovered that lightning stories were very popular with the public. Not only is lightning a beautiful natural phenomenon with interesting science to explain it, but stories involving safety messages appeal to people because of the death and disability it can cause, the drama of survivors working to get better, and the education provided about how to avoid injury.

The media often calls lightning experts to explain what happened with a recent lightning injury to someone in their own hometown. They are always encouraged to include lightning safety messages and made to feel that they will save lives with their story. Because of the active involvement of the media, there is no question that they have had a huge role in spreading lightning safety information and have undoubtedly prevented many injuries and deaths as a result.

5 PROGRESS REPORT

Over the past fifteen years, many other changes have occurred in the US because of lightning safety efforts. In some areas, storm warnings issued by the US weather agency routinely include warnings for 'dangerous lightning' organizations such as the Red Cross, the Boy Scouts, Little League Baseball, soccer and others have included lightning safety information and

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protocols in their training materials for coaches, leaders, and participants.

Professional, college and high school games are now routinely delayed or cancelled when thunderstorms approach and lightning is seen or heard. Golf clubs have posters in their pro shops as well as information tags for player's golf bags. Backpackers, campers and those in other outdoor activities are routinely advised of lightning safety recommendations in their literature and at the trail heads.

At least partially because of these aggressive educational efforts, the number of people killed by lightning annually has steadily decreased by nearly two thirds, from over 70 per year before the 1990's to only 26 in all of 2011.2 The fatality rate in the US is now 0.1/million population.

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