An (Incomplete) History of Lightning Safety

Mary Ann Cooper, MD
Director, African Centres for Lightning and Electromagnetics Network
Professor Emerita, Department of Emergency Medicine, University of Illinois at Chicago
macooper@uic.edu

Abstract—This paper expands a paper one the US lightning safety campaign and includes the names and publications of some of the most influential contributors to lightning safety worldwide prior to 2000.

Index Terms— Lightning safety, lightning injury prevention, lightning detection, lightning injury, safety campaign, injury prevention.

I. INTRODUCTION

There have surely been deaths from lightning for as long as humans have been alive. However, prior to 1970, there is little record of significant lightning safety and injury prevention efforts. This short paper will broaden and add to a paper detailing the US lightning safety campaign that was presented at the ILCP conference in Vienna in 2012 and endeavors to credit as many people, studies, and groups involved before 2000 that it is possible to fit in [1]. Lessons learned details ideas that may be helpful to countries threatened by lightning in developing a lightning safety program.

II. HISTORY

The modern history of lightning safety begins with Dr. Nobu Kitagawa. (Fig. 1). On August 1, 1967, 46 members of Matumoto Fukashi High School by lightning as they were hiking in the Japanese Alps. Eleven were killed and 14 were seriously injured [2]. Following this tragic accident, Dr Kitagawa organized a research group of physicists, high voltage engineers, and physicians, some of whom had cared for the victims. Among other things, they simultaneously investigated simulated lightning discharges on the human body in the high voltage lab, set up animal models of injury, investigated incidents involving humans and animals including the meteorological conditions, injuries, medical care, autopsies, damage to clothing, trees and surroundings at strike sites for a total of 73 individual incidents. Their research contributions, reported over decades, are incalculable [2-15]. They went the final step and developed one of the first international lightning safety codes that served as an early guide to lightning safety education and injury prevention [6,7]. Dr Kitagawa, now retired and in his 90’s, has been a mentor and advisor to lightning researchers around the world. In 2003, he received the first Kitagawa International Medal of Keraunomedicine.

As important as the medical aspects is to lightning safety is the knowledge of where and when lightning strikes. 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. This technology was the basis for the US National Lightning Detection Network (NLDN) which began providing uniform national information to researchers and operational users at the start of 1989 and is now used by many other countries as well [16].

Despite the work of Kitagawa’s team, there was little published in the English medical literature about lightning injuries prior to 1980. Cooper had begun her work in electrical injuries in the late 1970’s as a resident in emergency medicine. On reviewing the lightning literature she found only isolated case reports and older general reviews which she collected into her 1980 paper, the first organized medical study of lightning injuries and fatalities [17].

Some of the first papers available on lightning safety were published by people from mining and electrical utilities in the 1980’s [18-20]. Unfortunately, collaboration between physics, engineering, medical and others interested in lightning safety was seriously hampered because their literatures were isolated and not as easily available from indexing services as they are today.

In 1990, international lightning safety recommendations were first proposed at the 20th International Conference on Lightning Protection (ICLP) [6,7]. Six years later, some of the authors of the 1990 recommendations joined others at the 23rd ICLP to amend and reissue the recommendations [21].

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

Fig. 1. Nobu Kitagawa with the Kitagawa International Medal of Keraunomedicine at ICOLSE 2003
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. They expected to see
thousands of flashes but found only two which led them to
begin studying the circumstances of lightning injury [22].

Michael Cherington, another physician, published his first
paper on lightning injury in 1990 which caught the attention of
Ron Holle and Raúl Lopez. They began collaborating and
founded the Lightning Data Center in February 1992. The LDC
members worked together publish a paper that became the
basis for the commonly accepted 1:10 ratio of deaths to injuries
[23].

The circle widened in 1991 when Holle and Cooper met in
Chicago when Mr Holle was attending the retirement party of
Ted Fujita. A long and fruitful collaboration began [24]. At
about the same time, Chris Andrews, another physician,
contacted Cooper about a book he proposed to edit with David
Mackerras and Mat Daryvenza that was an outgrowth of the
PhD work he was doing in electrical engineering at the
University of Queensland [25]. Dr Andrews has been
instrumental in lightning safety and research in Australia.

The international support group for survivors, the Lightning
Strike and Electric Shock Survivors International, Inc., held
their first meeting in North Carolina in 1991 [26].

In 1996, Brian Bennett, an athletic trainer, found that few
college athletic programs considered lightning to be a risk
worth addressing. He and Katie Walsh Flanagan worked with
the National College Athletic Association to publish guidelines
for coaches about delay or cancellation of practices and games
[27-29]. These guidelines, updated regularly, serve as an
‘authoritative’ paper that parents are urged to use with their
local volunteer and school coaches and are available at
www.lightningsafety.noaa.gov.

In 1997, a meeting in Chamonix, catalyzed by a fatal
lightning incident in the Alps, was the first time that a
substantial number of experts from medicine, engineering and
physics and from many countries had an opportunity to meet
and interact [21].

William Roeder, a meteorologist at the Kennedy Space
Center became involved in public lightning safety education in
1998 when the Lightning Safety Group (LSG) met at the
American Meteorological Society meeting in Phoenix,
Arizona, and has been a prolific safety researcher and slogan
maker for the US Lightning Safety Week committee [30-38].

In 2004, Chandima Gomes, originally from Sri Lanka and
now in Kuala Lumpur at the University of Putra, began giving
lightning injury prevention lectures to groups throughout Asia
and has started lightning safety efforts in multiple countries on
three continents, including this WOMEL conference [39-42].

Since 2000, many more people have become involved in
lightning safety around the world. Some have done the first
injury surveys in their countries or other single studies. Some
have continued in their work but many have not perhaps
because they lack the support, knowledge, energy or free time
to pursue work that is largely unreimbursed.

### A. Lightning Safety Group Recommendations

The Lightning Safety Group (LSG) was an ad hoc meeting
of US lightning experts from industry, academics, medicine,
physics, athletics, insurance, meteorology, and research who
met at the AMS meeting in 1998. They realized that many old
and untested lightning myths were often at odds for teaching
safety [32,43,44]. New research on inter-strike distances and a
desire to be consistent with messages, especially to the media,
prompted them to write a consensus statement on lightning
risk, safety and injury prevention [45]. Recognized experts in
lightning from around the world were asked for input prior to
publication.

The statement 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 [46-48]. They also recommended lightning safety
action plans, the ‘30-30 rule’ and teaching about safe and
unsafe areas. The Lightning Safety Guidelines (LSG) were
published as widely as possible in the journals of the
participants. Position statements incorporating LSG were
developed by the National Athletic Trainers Association and
the American Meteorological Society [49,50].

### B. A Model Program and Resource for Lightning Safety

The first national Lightning Safety Awareness Week
(LSW) was held in the US in June 2001. Many of the LSG
writers were invited to participate in conference calls planning
the week, writing and designing LSW website (www.lightningsafety.noaa.gov), and contributing to LSW
information packets for regional government weather offices.
The first LSW 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, and a physician.

Over the next 15 years, the death rate from lightning in the US
plummeted to less than 1 in 10 million population in large part
to media stories and documentaries on lightning as well as the
work of broadcast and government meteorologists. Over the
years, LSW committee members have made themselves
available for hundreds of lectures to various groups and
interviews from newspapers, radio, and television stations all
over the world, for podcasts and nearly any other work the
media has proposed.

The LSW website (www.lightningsafety.noaa.gov) remains the best and most complete website on lightning safety
in existence with links to all pertinent websites. It is checked
and updated several times per year. Best of all, all of the
materials on the LSW website is available for free download
including curricula and games for preschool-grade 12, safety
toolkits for large venues such as stadia, beaches, and concerts,
medical aspects, ongoing data collection of US lightning
deaths, a media section, useful statistics, animations of
lightning physics and mechanisms of injury, posters of
celebrity spokespersons and Leon the Lightning Safety Lion,
and many other materials that can be useful for lightning safety
campaigns in other countries. Many of the website developers
have volunteered to help customize materials to include faces,
languages and situations that are appropriate for other countries.

C. Development of Lightning Safety Education, Slogans and Materials [40,47]

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). Over the last five years, this has been largely abandoned, except for certain applications, 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.

Most of the materials developed for the LSW on the NOAA lightning safety site apply to developed countries and are aimed at getting or keeping people inside safe areas such as substantial buildings (with plumbing and wiring running through the walls) and all metal vehicles. Unfortunately, 90% of sub-Saharan housing and that in many other tropical and sub-tropical, high lightning density areas are built from mudbrick, thatch, sheet metal and other insubstantial, non-lightning safe construction. The challenge will be to develop lightning safety messages and programs that are appropriate to these areas, speak in the area languages, address cultural beliefs, and are effective.

III. LESSONS LEARNED [30,37,51]

A. Gather the Myths and Cultural Beliefs of the Community that Need to be Addressed [32]

In most communities affected by lightning, there are many cultural beliefs, even ‘superstitions’ about lightning. Many of these, such as covering mirrors are not harmful [52]. However, others that affect personal and community safety need to be addressed by safety education but may be part of long held beliefs. Some of these include the belief that metal attracts lightning (it does not), that wearing shoes with rubber soles provides adequate protection (it will not), and that lightning can be called down by witches or deflected by ‘rainmakers’. Novel ways to address or work around these beliefs without impugning the person’s intelligence, ancestral beliefs or religion may need to be developed.

B. Talk to the Parents and Children

Lightning safety educators found that giving warnings to adults about lightning safety had little impact, partially because adults have a tendency to feel invulnerable and not at risk or because they are busy earning a living and cannot interrupt their activity to travel long distances to safer areas when thunderstorms threaten. LSW learned to change focus to working with parents and their children. Parents are much more likely to change their behavior and that of their children when they fear that harm will befall them. Efforts aimed directly at children are also very effective as they take the safety message home to their families [39].

C. Use Proactive, rather than Reactive Messages

Recommending that people check the weather report before beginning an activity is a great step, provided they have access to accurate weather forecasts.

Admitting that ‘Lightning Safety is not Convenient’ and that people may need to change their behavior to increase their safety is essential. It sets the stage for a new way of approaching the problem of lightning safety.

Giving people a long list of ‘Do Not Do This, or Do Not Stand There’ types of instructions is not as helpful as telling them what they should DO, preferably with short, succinct messages that they can remember in times of crisis.

Encouraging people to form a ‘lightning safety plan’ for their work area or before an event or family/church gathering is much more effective than leaving them to react to a thunderstorm when it is upon them. Their lightning safety plan should include safer areas to go to and the time to get themselves and anyone they are responsible for to that area. For larger venues, work situations, or large sports events, the US has developed tool kits to develop lightning safety plans [48]. These may or may not apply to developing countries.

An Example: When parents in the US complained that their children’s coaches were resistant to stopping games for lightning, they were given or referred to the NCAA coach guidelines [29]. Parents could present their children’s coaches with a print out before the season started 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 in the US have become the biggest proponents of lightning safety on the playing field.

D. Use Different Messages and Methods of Messaging for Different Audiences [39]

In urban areas, the message may be to seek shelter in the substantial buildings that are available. In rural areas, other messages are more appropriate and need to be developed and tested for the developing countries.

In high literacy areas, videos, podcasts, lectures, and school programs are often appropriate. In areas with lower literacy, street plays, dramas, folk songs, storytelling, and posters and billboards that show the recommended behavior may be more appropriate. Cell phone messages or texts may also be useful [53].

Example: Even 3 and 4 year olds can be taught lightning safety by having them role play while others simulate the sounds of rain and then thunder. As soon as they hear the ‘thunder’, they stop their activity and run into their play house.

E. Form Multidisciplinary Groups When Possible

Addressing lightning safety takes more than one person working on it. A ‘critical mass’ of workers is important for each person to feel supported, plus an alliance usually produces more results in a shorter period. Recruiting a network of people with different skills and knowledge can improve the quality and tone of the messages and address the questions that
arise more effectively. Certainly, everyone at this meeting knows the impact of having an 'outside expert'.

F. Never Underestimate the Power of the Media

The media have an essential role in spreading the message and even in collecting data on injuries, if properly employed. The media discovered that lightning stories were very popular with the public, and, over the last three decades, lightning experts in the US 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 other networks. 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 call 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. There is no question that the active role of the media in promoting lightning safety has had a huge effect in spreading lightning safety information and has undoubtedly prevented many injuries and deaths in the US.

IV. SUMMARY

While lightning injuries in many developed countries around the world have decreased remarkably, the challenge of decreasing deaths, injuries and property damage from lightning in developing countries, especially those in the tropical and subtropical areas remains a huge job. This paper gives the history of lightning injury prevention and safety before about 2000, some of the lessons learned and tips for putting together a national lightning safety team.

ACKNOWLEDGMENT

Lightning Safety must be a group effort involving those with knowledge and energy. I would like to thank all of those in the world-wide lightning community who have been so patient and supportive and taught me so much in the last twenty-five years. Any errors or omissions of those working in lightning safety before 2000 are entirely my fault, for which I apologize. I would be happy to amend my knowledge as well as to share a more complete list of papers with any individuals who request it.

REFERENCES


