International Symposium on Forensic Science Error Management, July 21-24, 2015

Understanding and Detecting/Preventing/Mitigating Errors in Stair Fall-related Personal Injury Litigation Inspections and Other Legally Mandated Inspections

Jake Pauls
Certified Professional Ergonomist

Jake Pauls Consulting Services
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Through the entire 1960s, Jake Pauls had an eclectic academic life at the University of British Columbia, ending with an Architecture degree in 1969. Now a Certified Professional Ergonomist, he has 48 years of international experience in research, codes and standards development, plus consulting, focused on people's movement, individually and in crowds, especially on stairways, a special expertise utilized worldwide.

Widely published, Jake excels at bridging among ergonomics, public health and development of codes and standards for built environment usability and safety. He serves on 13 national/ international committees in the US, developing safety standards and model building codes, representing (*pro bono*) the American Public Health Association on over half of these.


Jake Pauls Consulting Services
Toronto, Canada, 2011—


Jake Pauls Consulting Services
Silver Spring, MD, USA, 1993—
Jake Pauls Consulting Services
Toronto, Canada, 2011—


Jurisdictions where Work Performed in Relation to Civil (and One Criminal) Actions
Iceland
Sweden
Norway
United Kingdom
Poland
Germany
Ukraine
France
Italy
Spain
Turkey
Canada
United States
Mexico
North Pacific Ocean
North Atlantic Ocean
Japan
Korea
Iraq
Algeria
Libya
Egypt
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
Kenya
DR Congo
Tanzania
Angola
Namibia
Botswana
South Africa
Venezuela
Colombia
Brazil
Peru
Bolivia
Chile
Argentina
Papua New Guinea
Australia
New Zealand
South Pacific Ocean
South Atlantic Ocean


Jurisdictions where Work Performed in Relation to Civil (and One Criminal) Actions*
*Such work makes up less than 10% of professional activity which has occurred in 80 percent of US states, 80 percent of Canadian provinces, and over a dozen other countries worldwide over a 48-year career.
Canada
Mexico
North Pacific Ocean
North Atlantic Ocean
South Atlantic Ocean
Iceland
Sweden
Norway
United Kingdom
Poland
Germany
Ukraine
France
Italy
Spain
Turkey
Iraq
Algeria
Libya
Egypt
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
Kenya
DR Congo
Tanzania
Angola
Namibia
Botswana
South Africa
Venezuela
Colombia
Brazil
Peru
Bolivia
Chile
Argentina
Japan
Korea
Papua New Guinea
Australia


Professional Activities
Mid-2015
Iceland
Sweden
Norway
Canada
Poland
Germany
Ukraine
France
Spain
Italy
Turkey
Japan
Korea
North Pacific Ocean
United States
North Atlantic Ocean
Iraq
Algeria
Libya
Egypt
Mexico
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
Venezuela
Colombia
Kenya
DR Congo
Papua New Guinea
Tanzania
Brazil
Peru
Angola
Bolivia
Namibia
Botswana
Australia
South Pacific Ocean
Chile
South Atlantic Ocean
South Africa
New Zealand
Argentina

2015 IEA
19th Triennial Congress - Melbourne

19th Triennial Congress of the
International Ergonomics Association

MELBOURNE • 9–14 August 2015

www.iea2015.org

Reaching Out

IEA
International Ergonomics Association

HFESA

Human Factors and Ergonomics Society of New Zealand Inc

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IEA
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HFESA

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Professional Activities Mid-2015 Leading Up to 2017

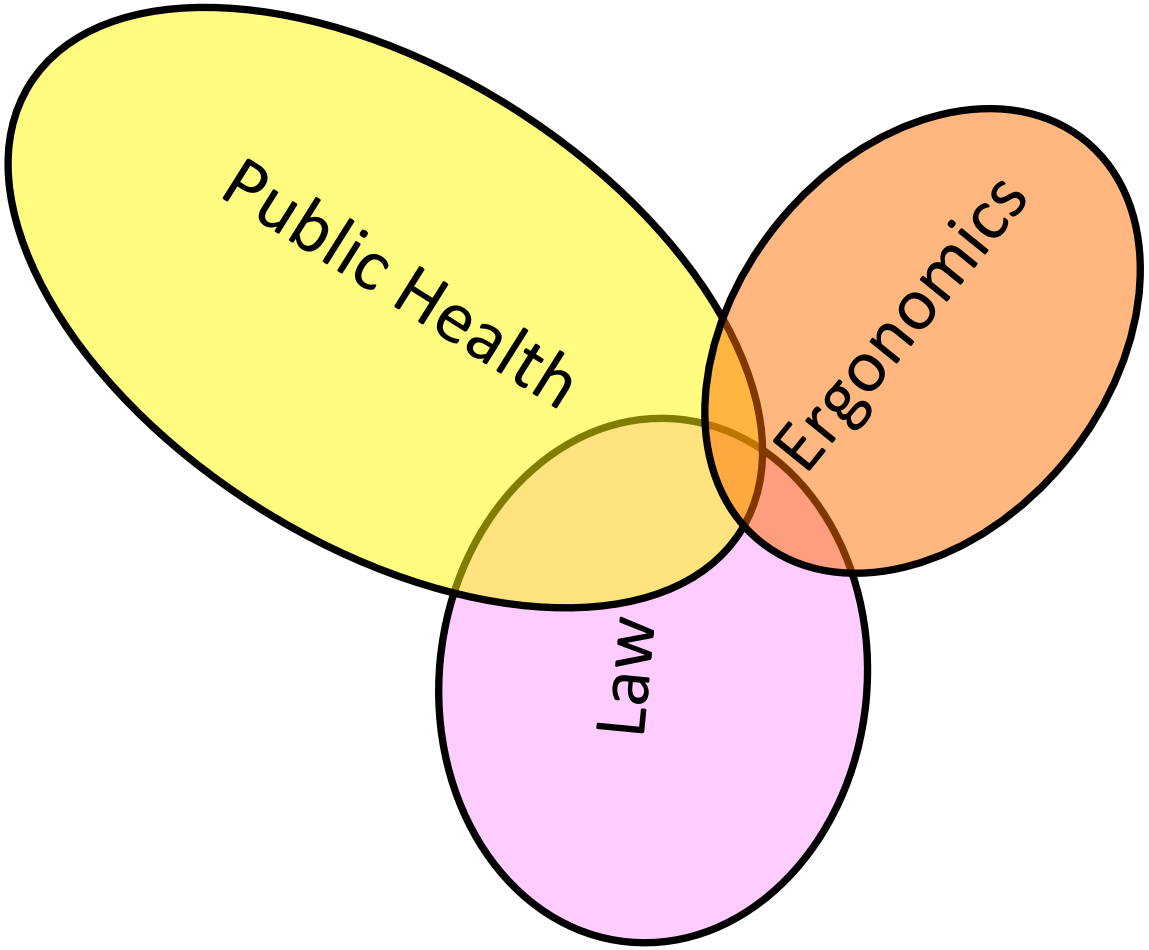
15th World Congress on Public Health

Monday 03 April 2017 - Friday 07 April 2017

The 15th World Congress on Public Health Australia, from 3 to 7 April 2017.

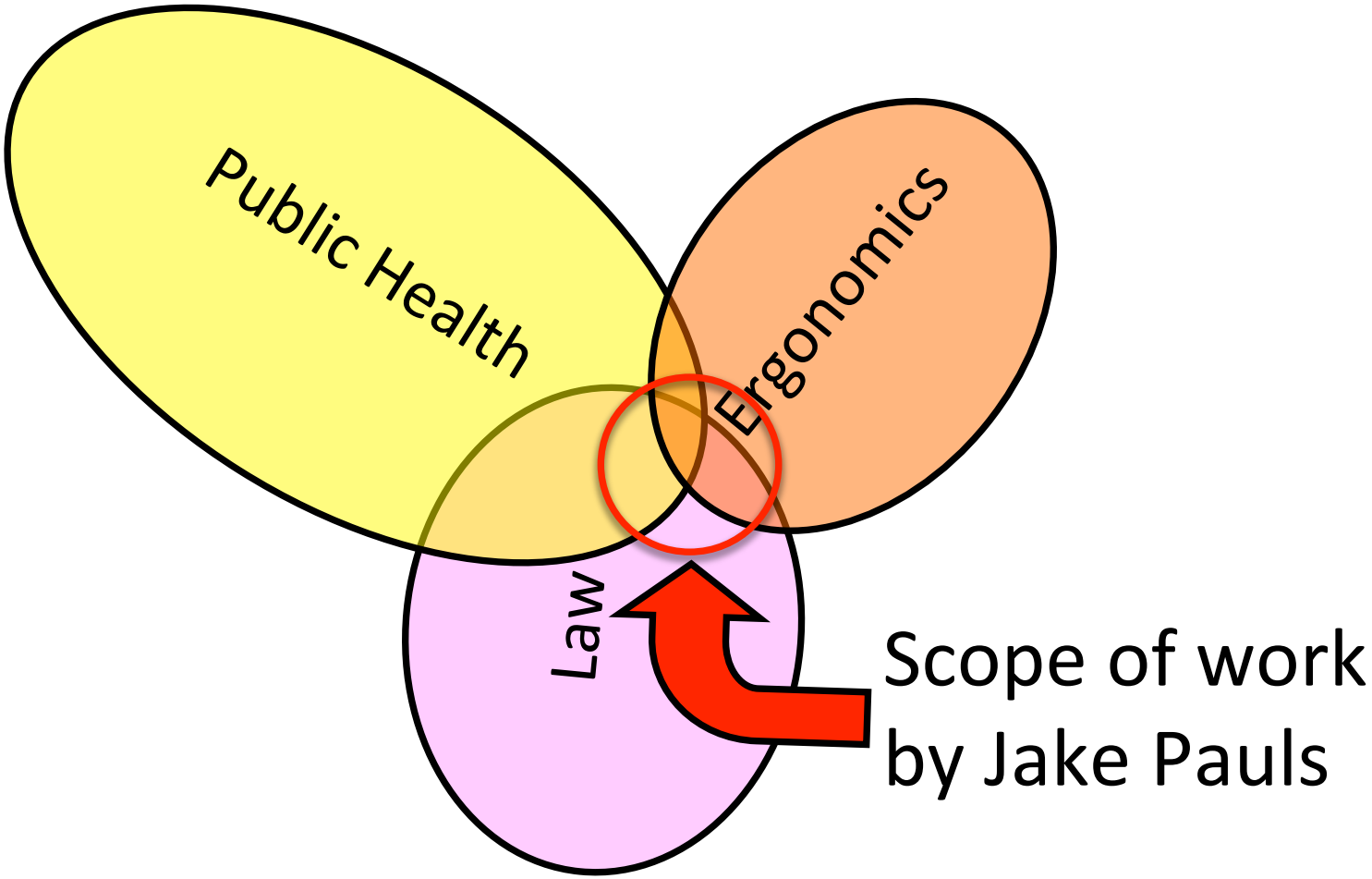
7-7 APRIL 2017
15th WORLD CONGRESS ON PUBLIC HEALTH
2017 MELBOURNE AUSTRALIA
VOICES • VISION • ACTION

Three Key Fields Pertinent to Jake Pauls' Work



"Law" includes Administrative Law (e.g., standards, codes, legislation and regulation) and Personal Injury Litigation

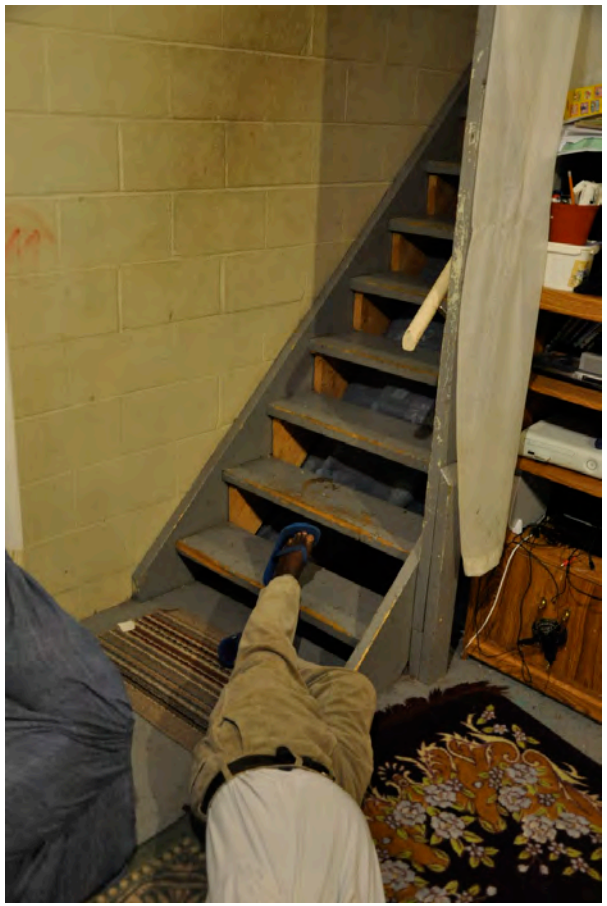
Three Key Fields Pertinent to Jake Pauls' Work

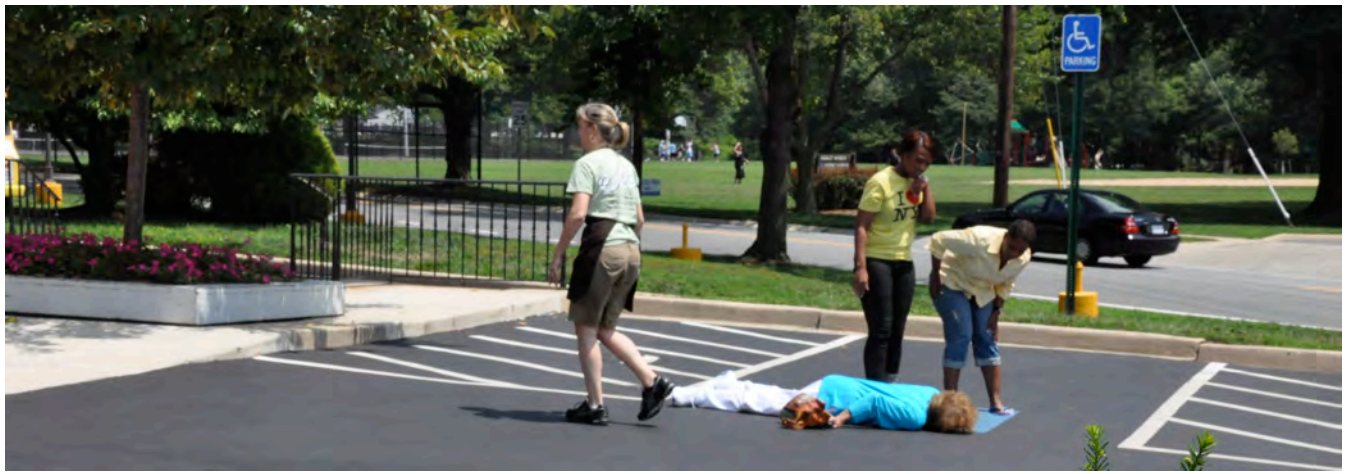


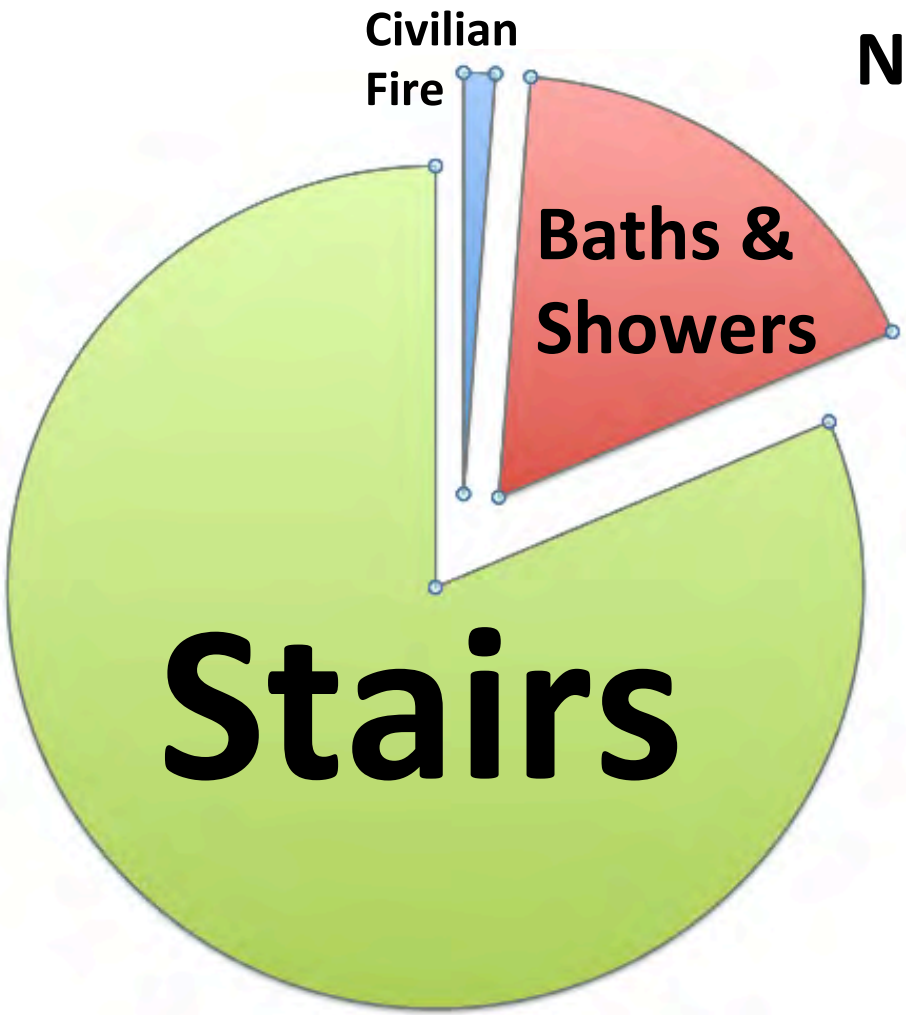
Professional Activity Consists of:

- Expert investigation of, and general research into, injurious falls in built environment, notably on stairs.
- Development, implementation of prevention and mitigation measures related to built environments.
- Improving efficacy of such measures when implemented in standards, codes, regulations for design, construction and management of facilities.
- Advocacy for improved investigation, documentation, reporting and use of information pertaining to the causes and contributing factors for injurious falls, especially those involving small elevation changes (e.g., stair steps, bathtubs, etc.) in pedestrian facilities.

Professional Activity Concerned with Injurious Falls Such as These





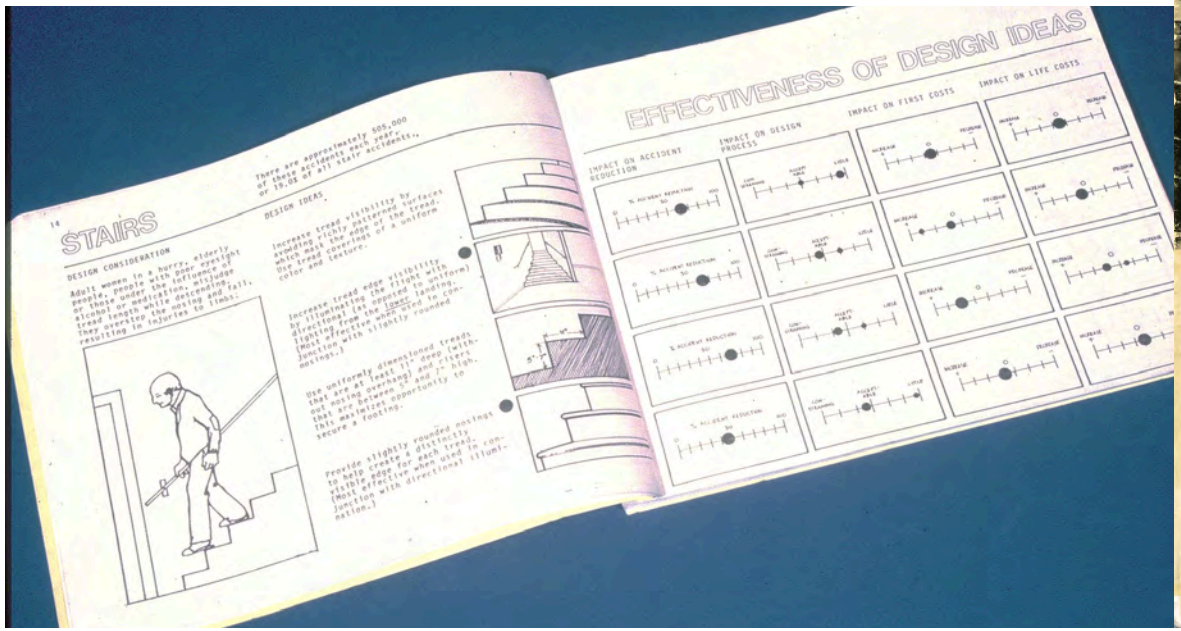


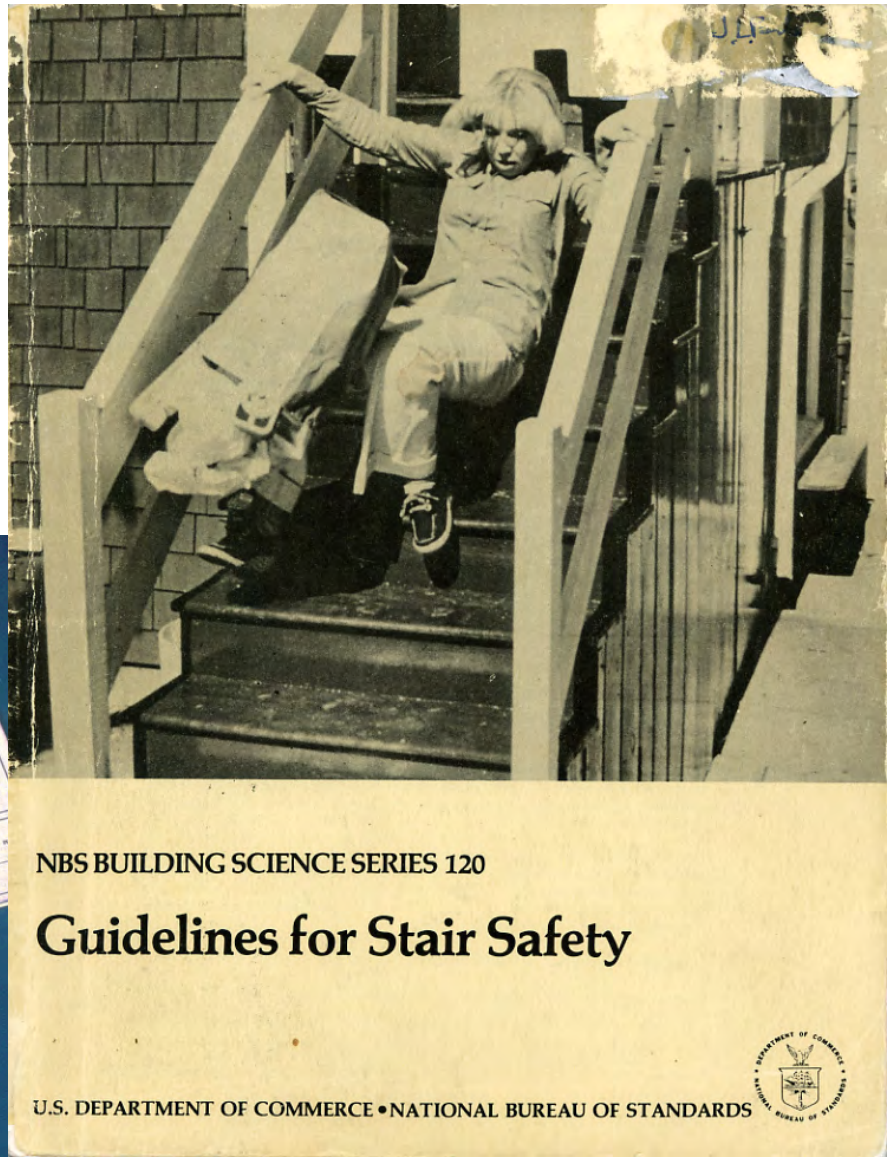
Three Selected Nonfatal Injuries* (ER-treated) in USA in 2010

- Civilian Fire Injuries
- Bath & Shower Injuries
- Stair-related Injuries

* Sources: NFPA and CPSC/NEISS

US NBS (now NIST) researchers knew of, and reported, these dangers in 1975, but the 1978 and 1979 reports were the last scientific reports—on epidemiology, etiology & countermeasures—issued on stairway safety by the US Government.





Stairway safety research—plus activity to prevent or mitigate predictable and preventable stair-related injuries—was briefly addressed by universities in the US and, more substantially, by national institutes in Canada, Japan & England.

The presenter's work in Canada, to which John Archea contributed (after his time as the stairway expert at NBS/NIST), was later applied—*at the request of US safety standards & model building codes organizations*—to US standards and codes from the 1980s to now. *Canada is now the world center for stairway safety and usability research* and the insights from that work continue to be exported into the USA for state-of-art codes and standards plus export services in forensics and to major organizations including the mass media.

NBC *Today Show* item, 12 June 2012

http://today.msnbc.msn.com/id/26184891/vp46703609%2346703609#46703609

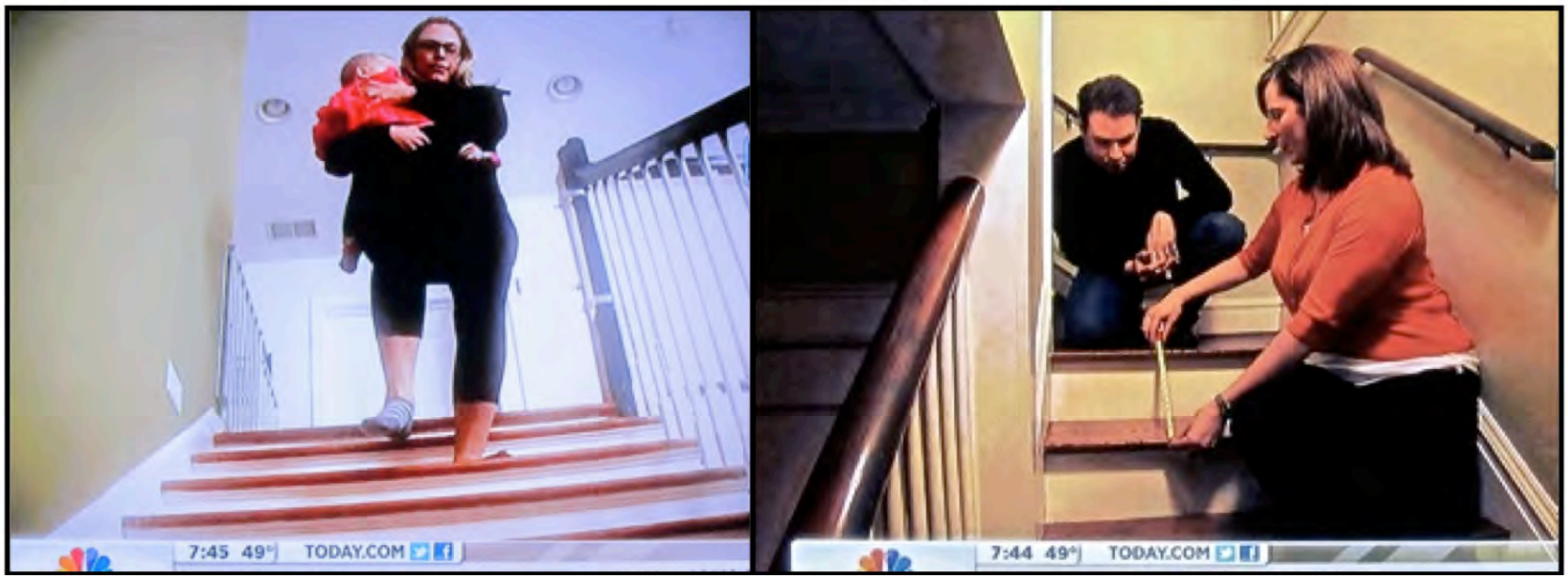
This morning prime time broadcast item presented valuable information on stairway safety, especially for homes—where most of the stair-related injuries occur. The quality of the presented information and guidance—to which no US Government agency contributed directly or indirectly—significantly exceeded that displayed by many so-called "forensic experts" who are retained by attorneys (especially from the Defense side) in civil litigation cases based on faulty stairways leading to injuries.

The errors—including stairway geometry documentation and analysis errors—made by some "forensic experts" reflect a low level of education, training and relevant experience in the stairway safety field. It reminds one of the dismal state of much of the fire investigation expertise which was dramatically presented on the second day of the NIST-hosted conference on errors in forensics science/technology, July 21-24, 2015.

NBC *Today Show* item, 12 June 2012

http://today.msnbc.msn.com/id/26184891/vp46703609%2346703609#46703609

Prime-time, 5-minute piece on home stairway problems—Top Of Flight Flaw (TOFF) "Chunky Handrails," and functional stair gates—to assess and improve safety of young children playing around or using stairs and being carried by adults.



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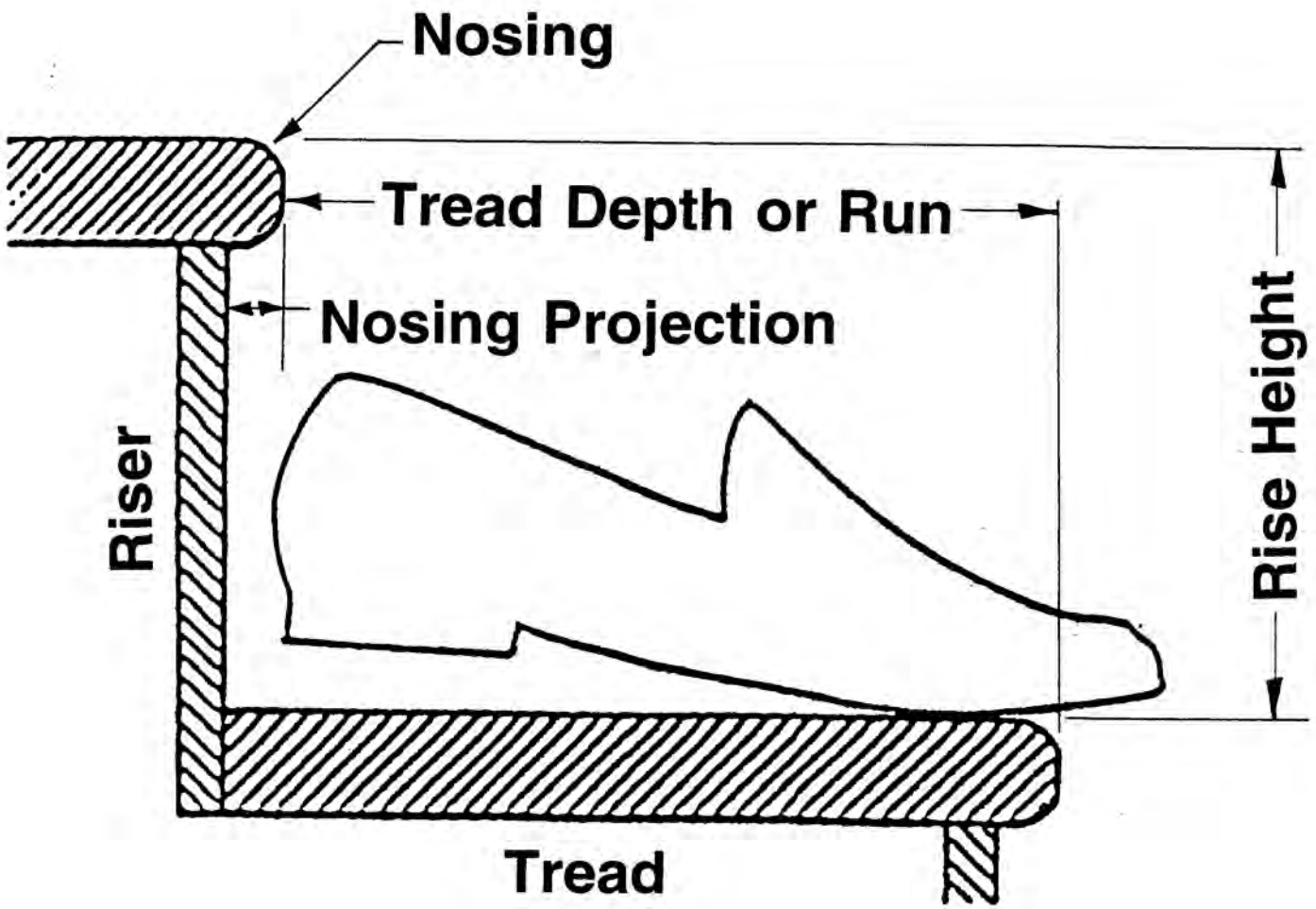
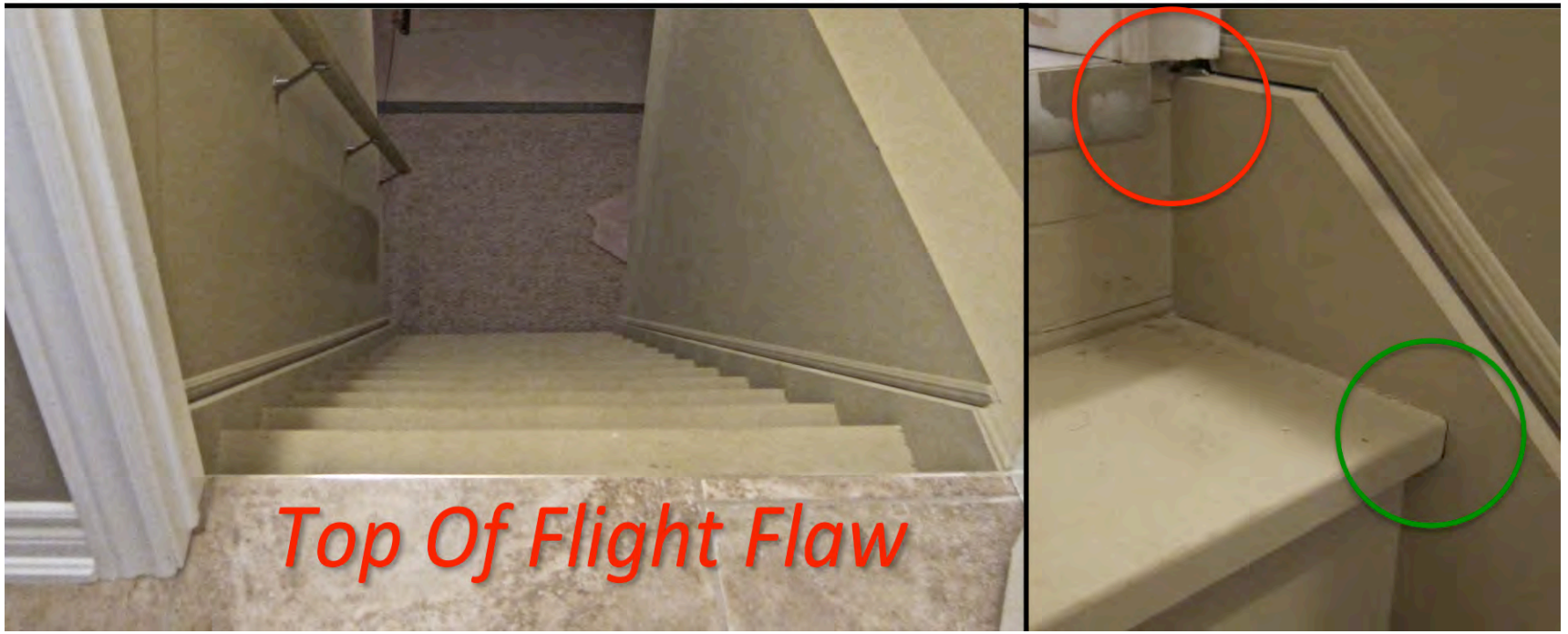

Nosing
Tread Depth or Run
Nosing Projection
Riser
Rise Height
Tread

Whereas nominal run dimension can increase risk within a factor of ten, dimensional nonuniformity can increase risk by one or two orders of magnitude (factors of ten to a hundred).

Whereas nominal run dimension can increase risk within a factor of ten, dimensional nonuniformity can increase risk by one or two orders of magnitude (factors of ten to a hundred). The systemic defect, *Top Of Flight Flaw* (TOFF), is due to the error of not making all nosings (the leading edges of steps) in a stair flight—*including the one at a floor or landing—project the same distance.*



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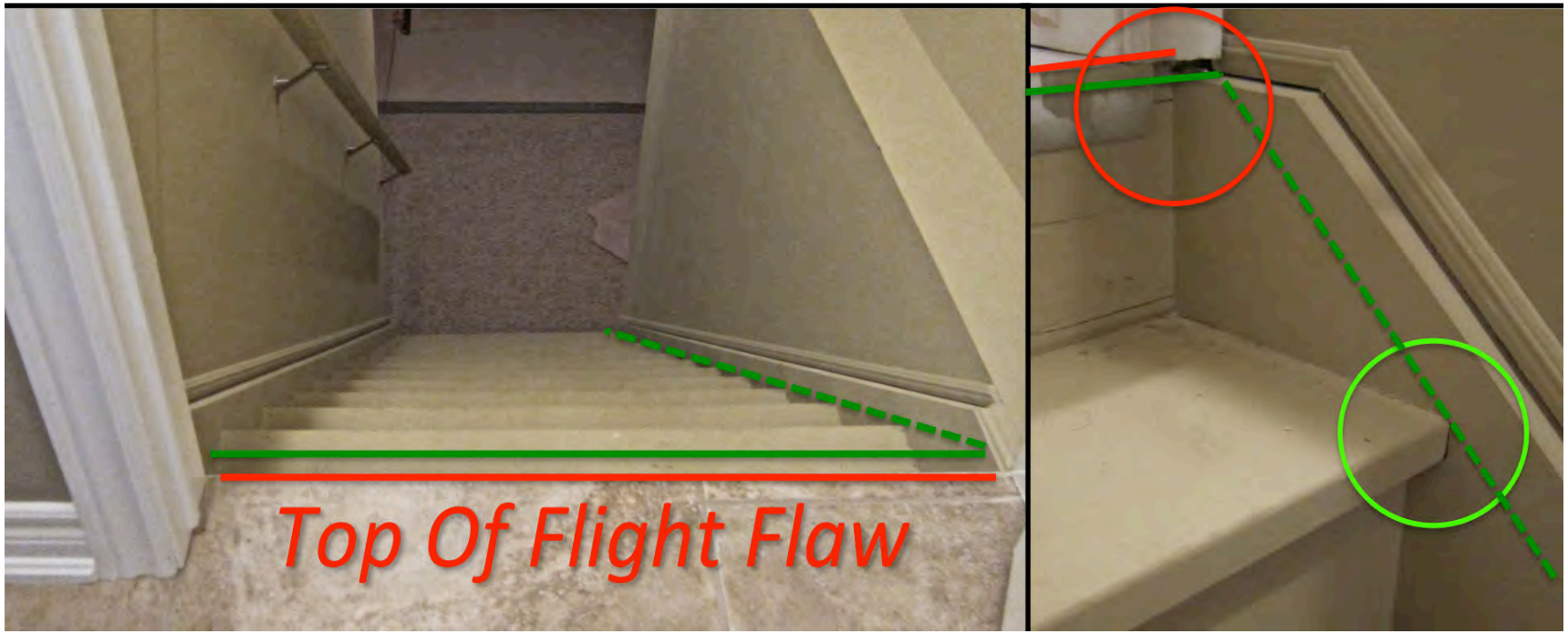

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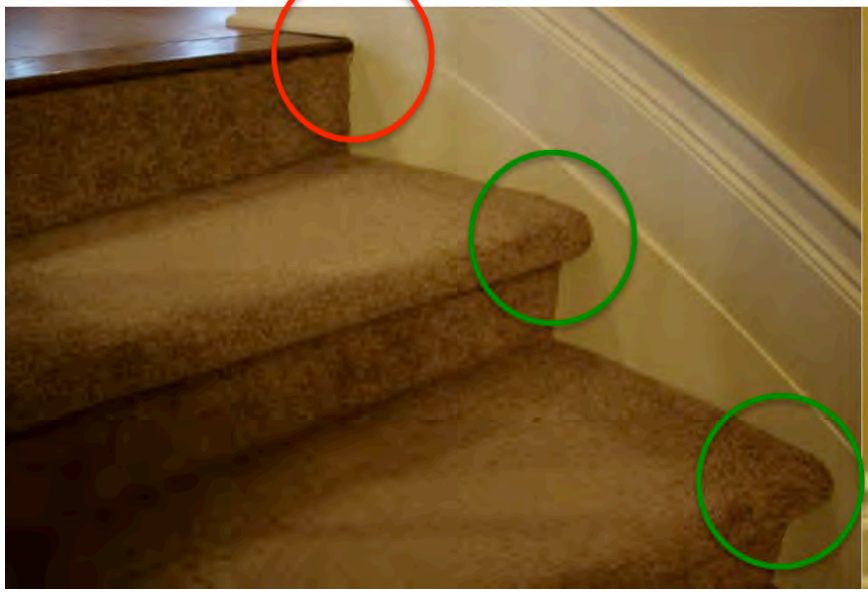
View to side of stair (at stringer)



View down the stair flight

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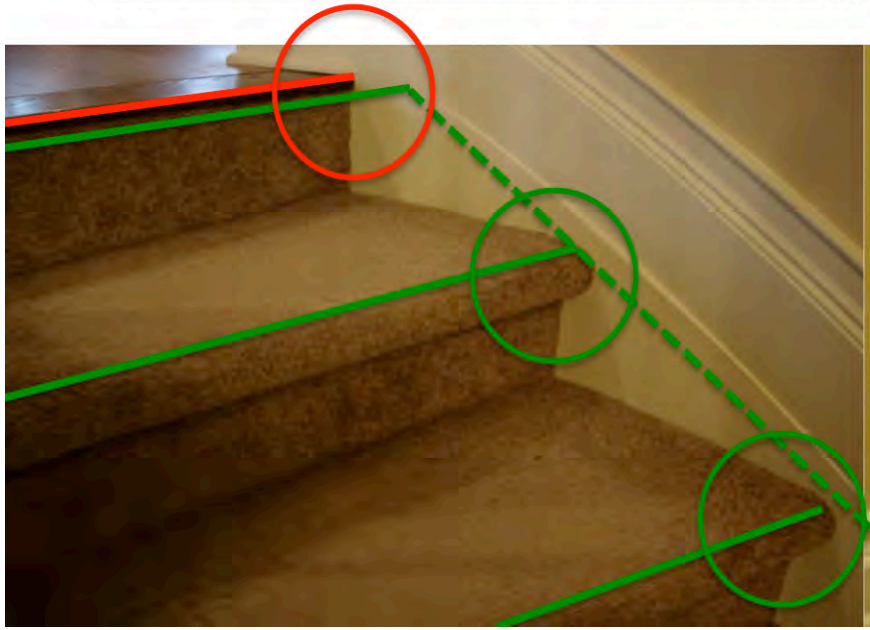
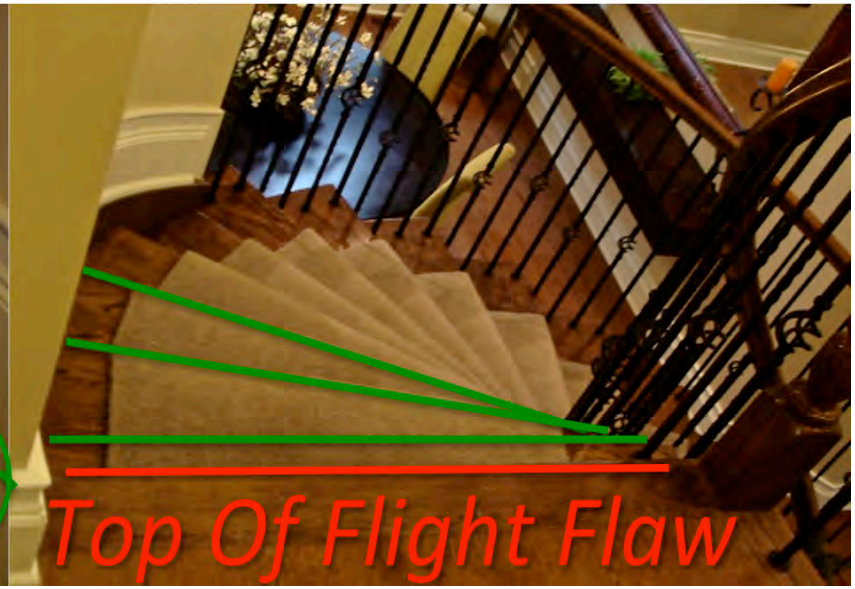
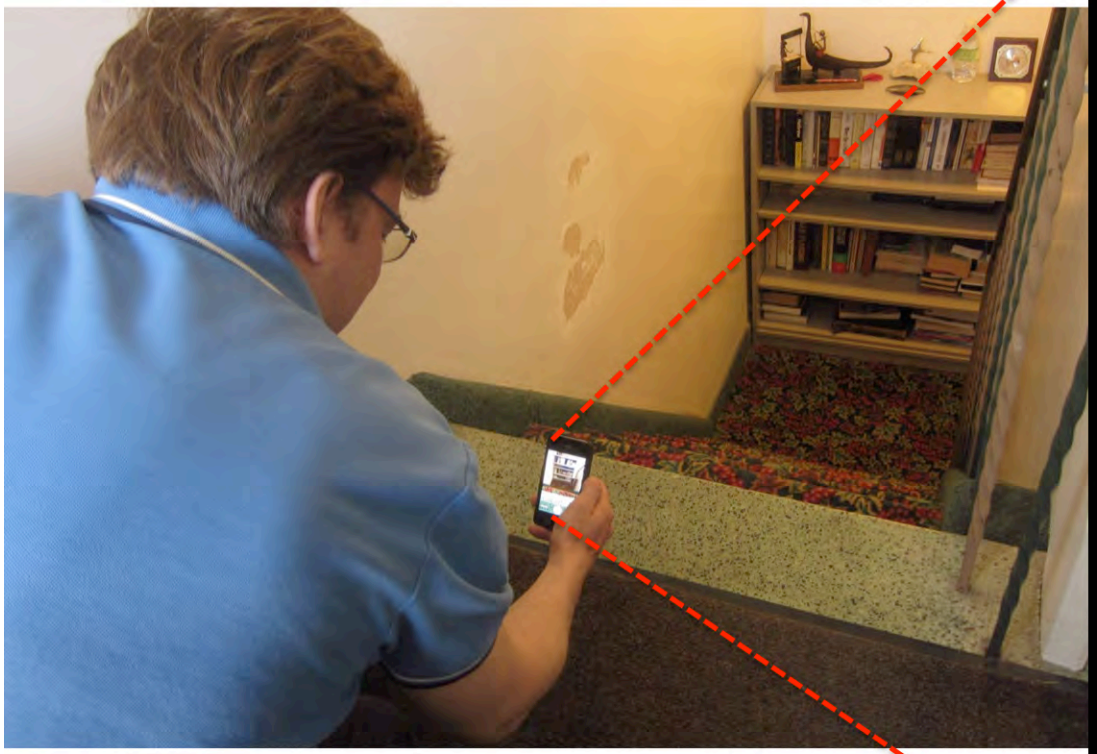


View down the stair flight



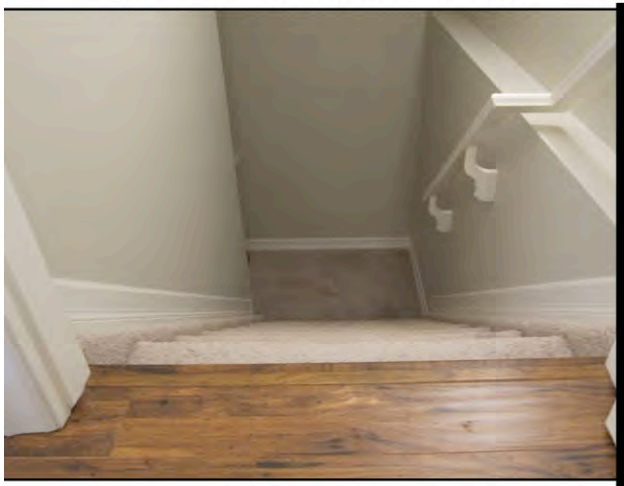
Smart phone App under development to aid professional and consumer detection of Top Of Flight Flaw (TOFF)



Smart phone App in use with "crouch and sight test"

Smart phone App under development to aid professional and consumer detection of Top Of Flight Flaw (TOFF) comparing subject and reference photographic views of "crouch and sight" test—*to see if all stair nosings line up*.

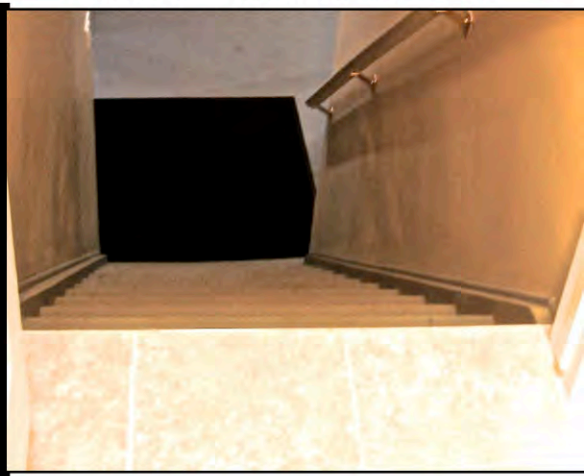
"TOFF" Reference



STAIR FAILS

Smart Phone Photo

"Good" Reference



STAIR PASSES

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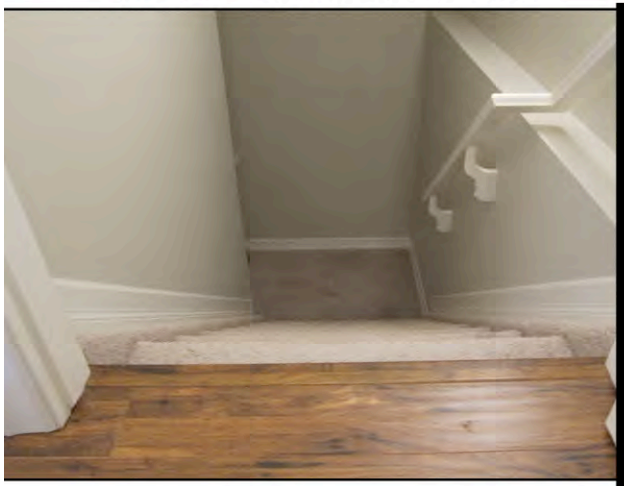

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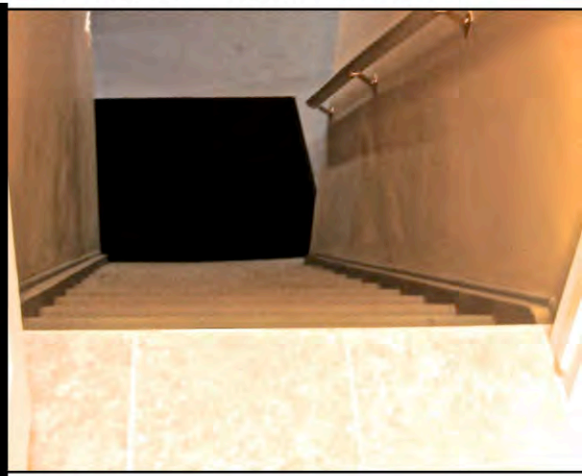


STAIR PASSES

Smart phone App under development to aid professional and consumer detection of Top Of Flight Flaw (TOFF) comparing subject and reference photographic views of "crouch and sight" test—*to see if all stair nosings line up*.

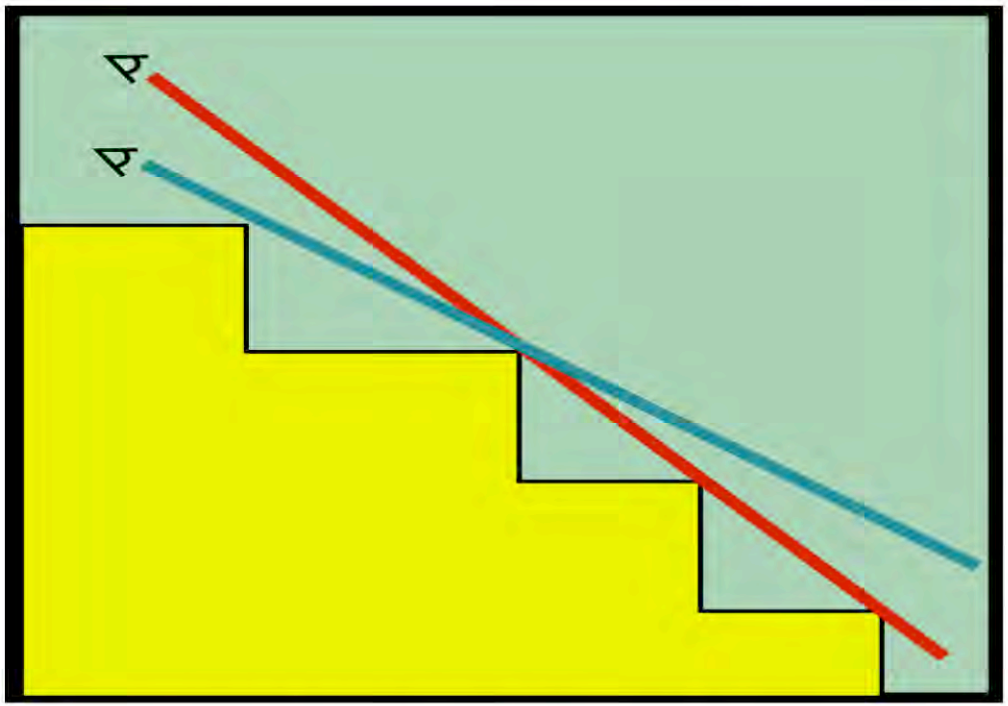
An additional role for the App is to collect data on the:

- Incidence of TOFF with a region, country, or larger area
- Jurisdictions where TOFF is more prevalent so that mitigation and prevention measures can be targeted.

Smart phones can readily determine locations and transmit that information to regional or national centres for data collection and analysis. Such options have been presented and discussed at a meeting of falls experts at the Toronto Rehab Institute (TRI), on June 5, 2015. *Potential economic benefits are very large ($millions/day).*

"Crouch and Sight" Test

Can Detect Most Top Of Flight Flaws (TOFF)

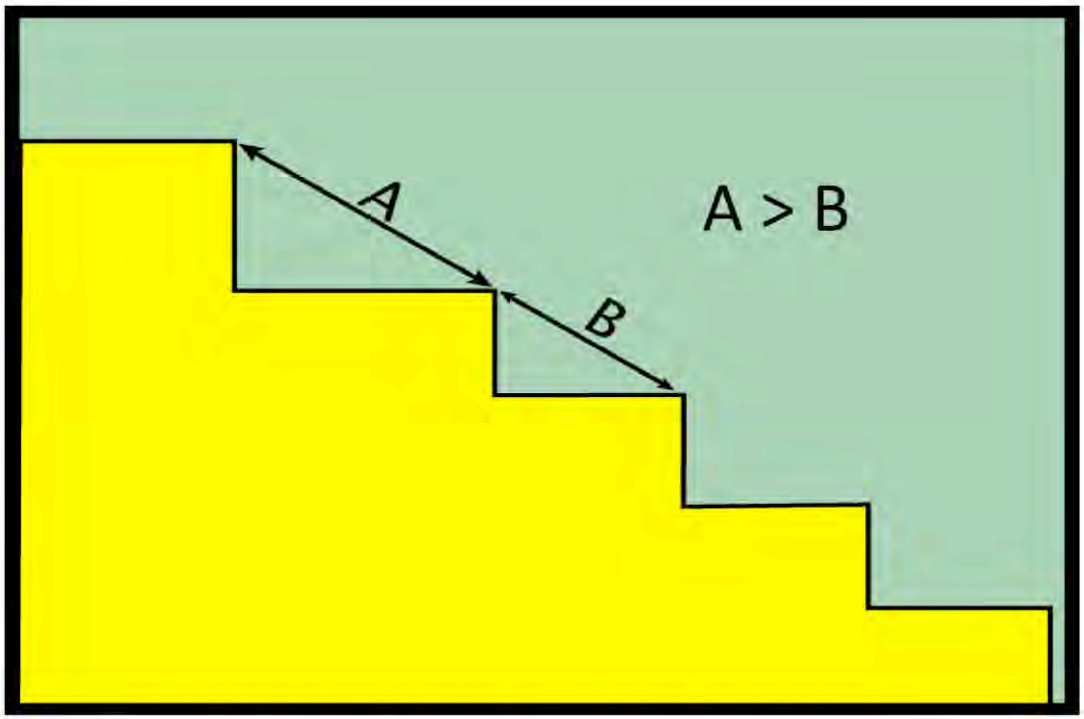


Graphic Courtesy of Daniel A. Johnson

By sighting down the nosings, the Flaw can usually be detected

Pauls, J. L. & Harbuck, S. C. (2008). *Ergonomics-based Methods of Inspecting, Assessing and Documenting Environmental Sites of Injurious Falls*

But "Crouch and Sight" Test May Not Detect This Flaw



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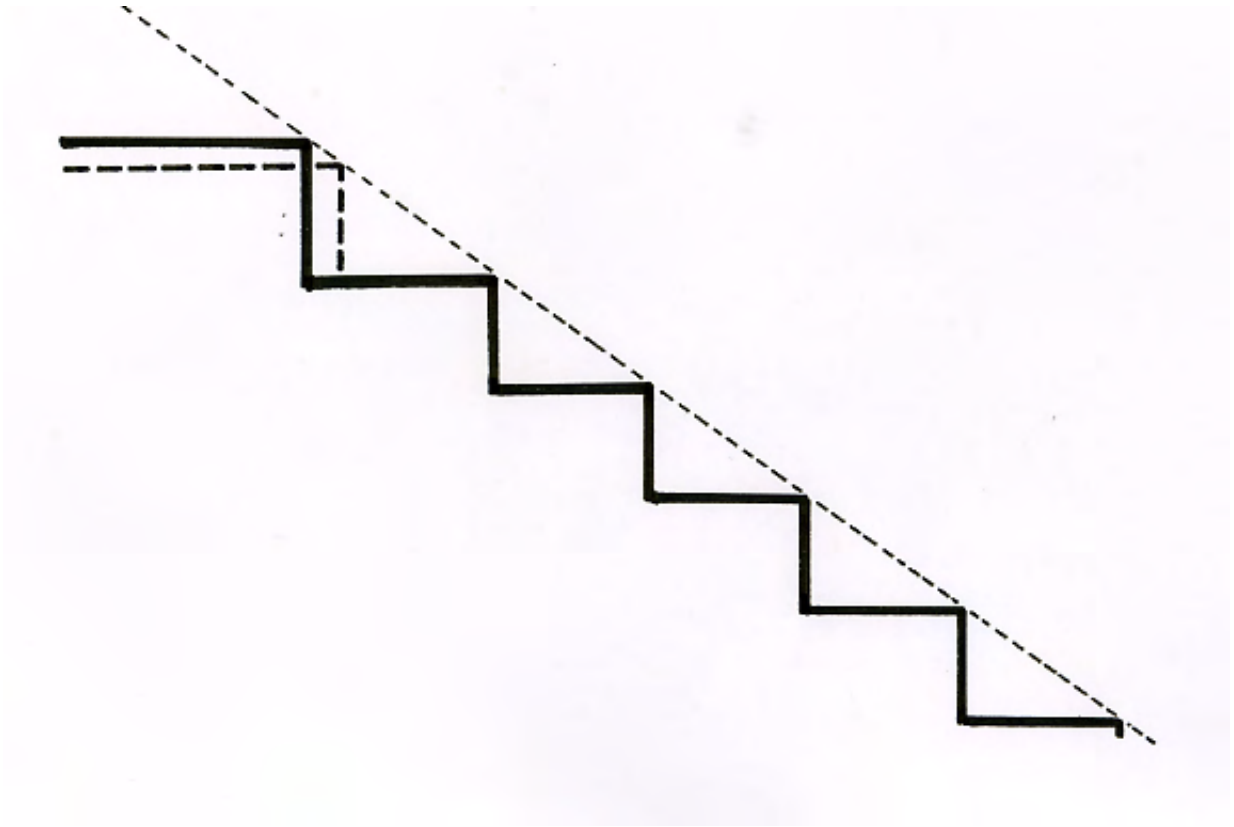
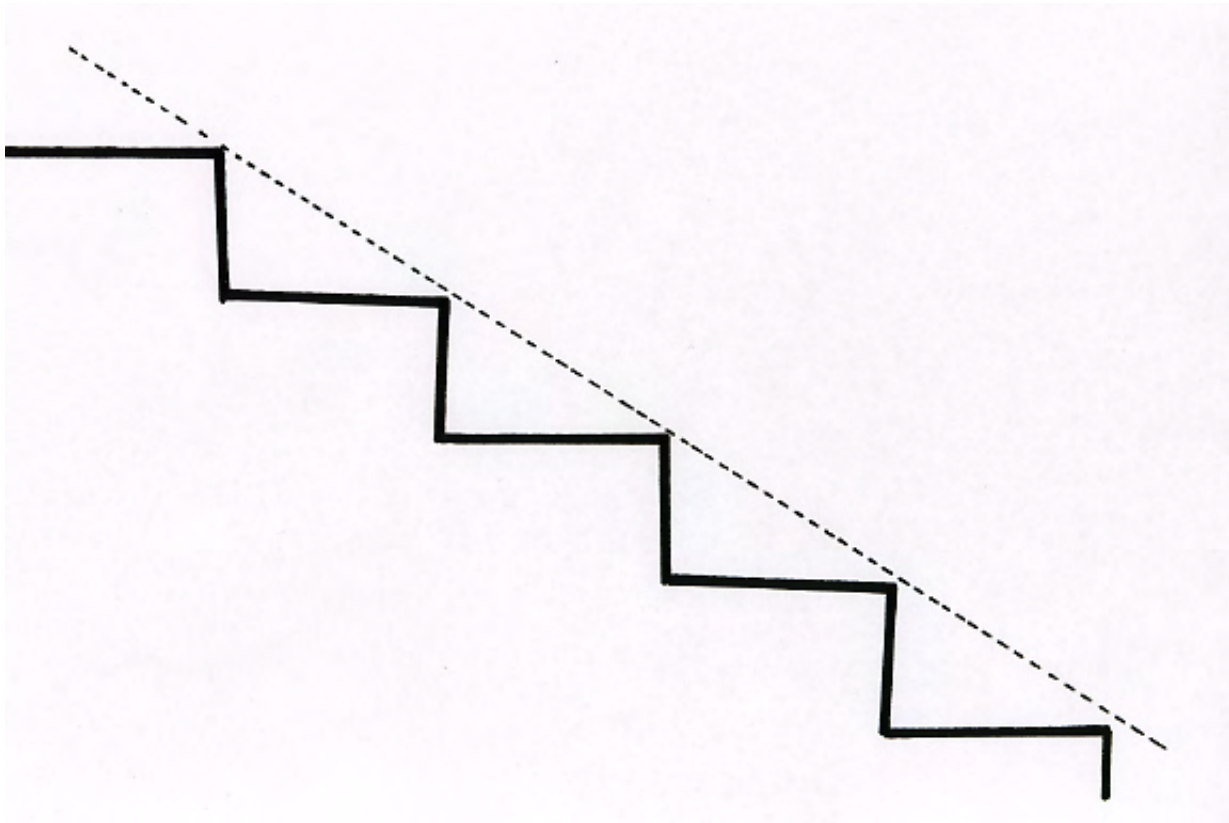
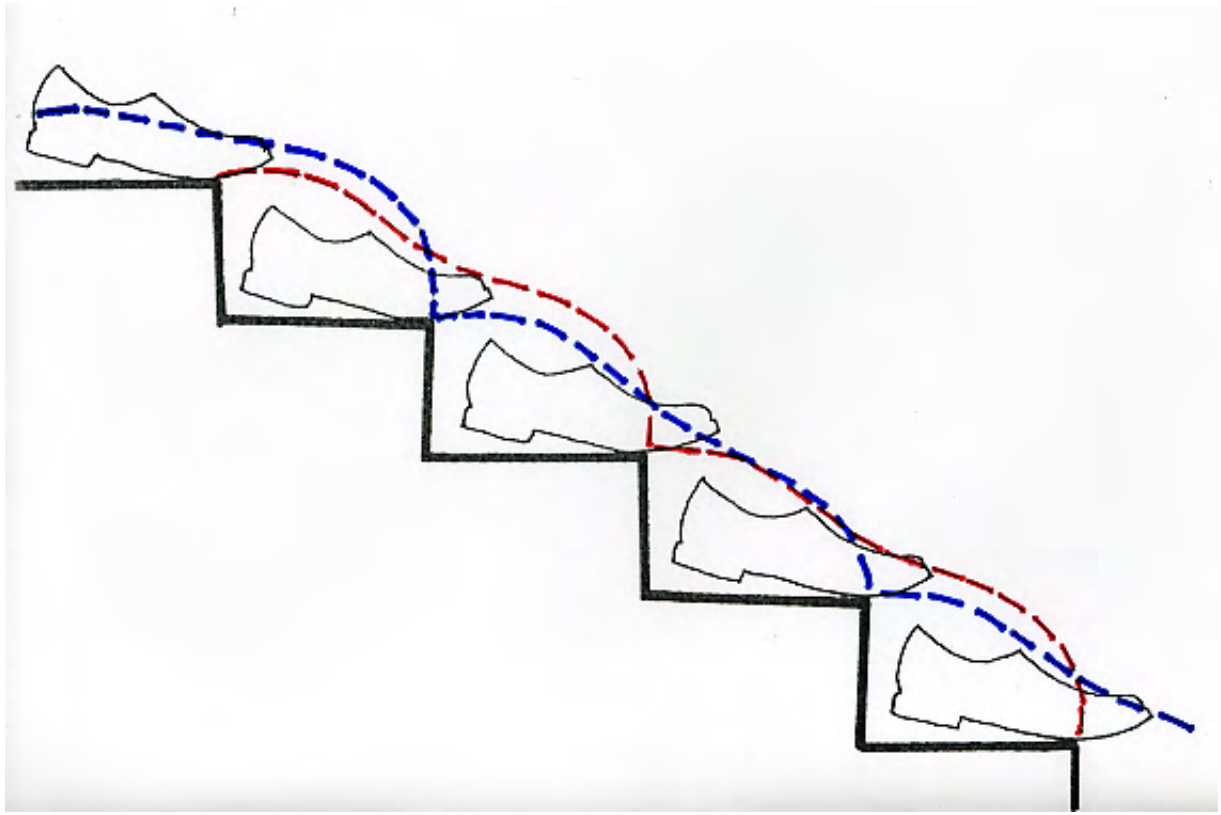
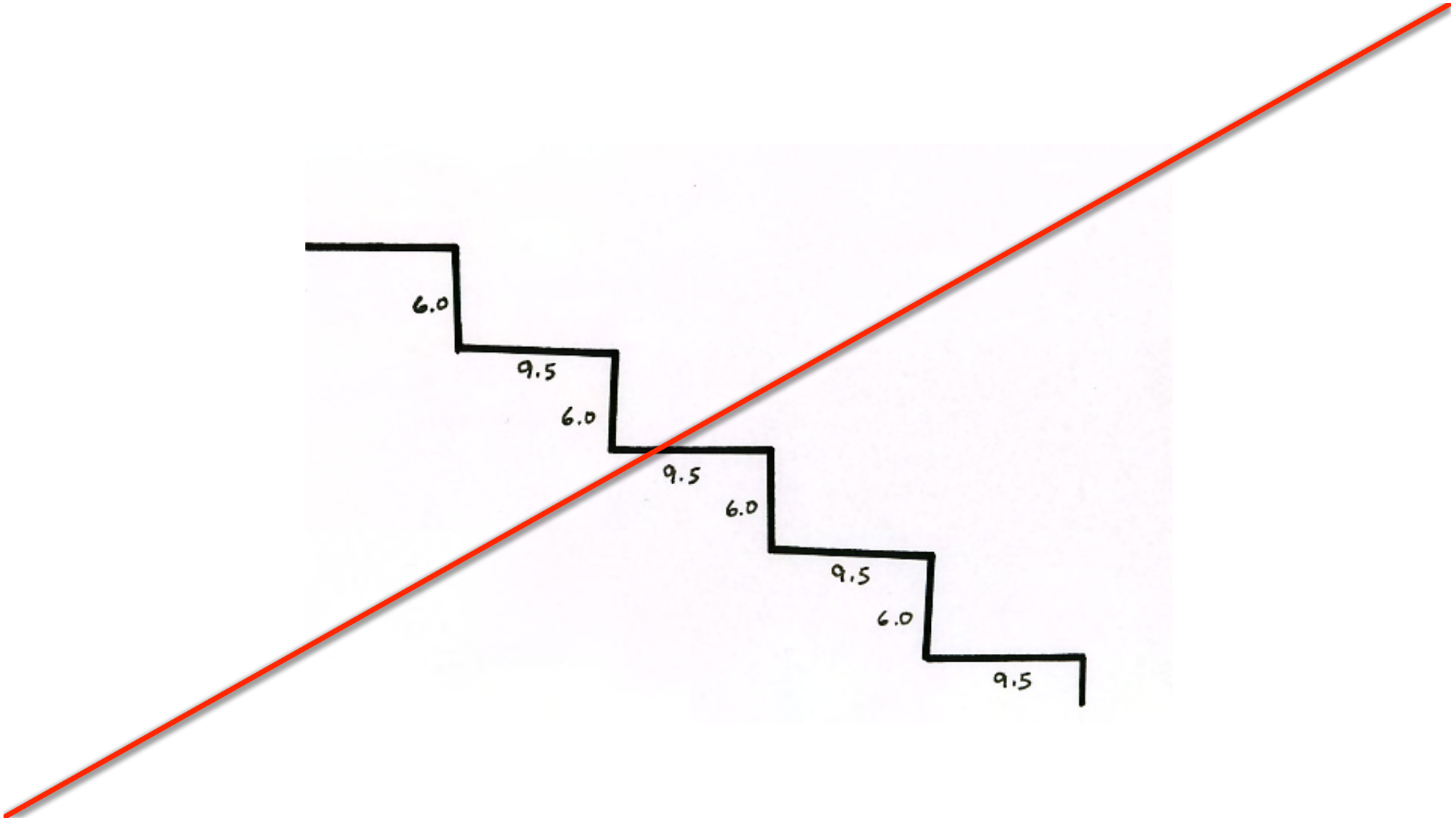
- Rarely, the nosings may line up, but the runs could still be non-uniform





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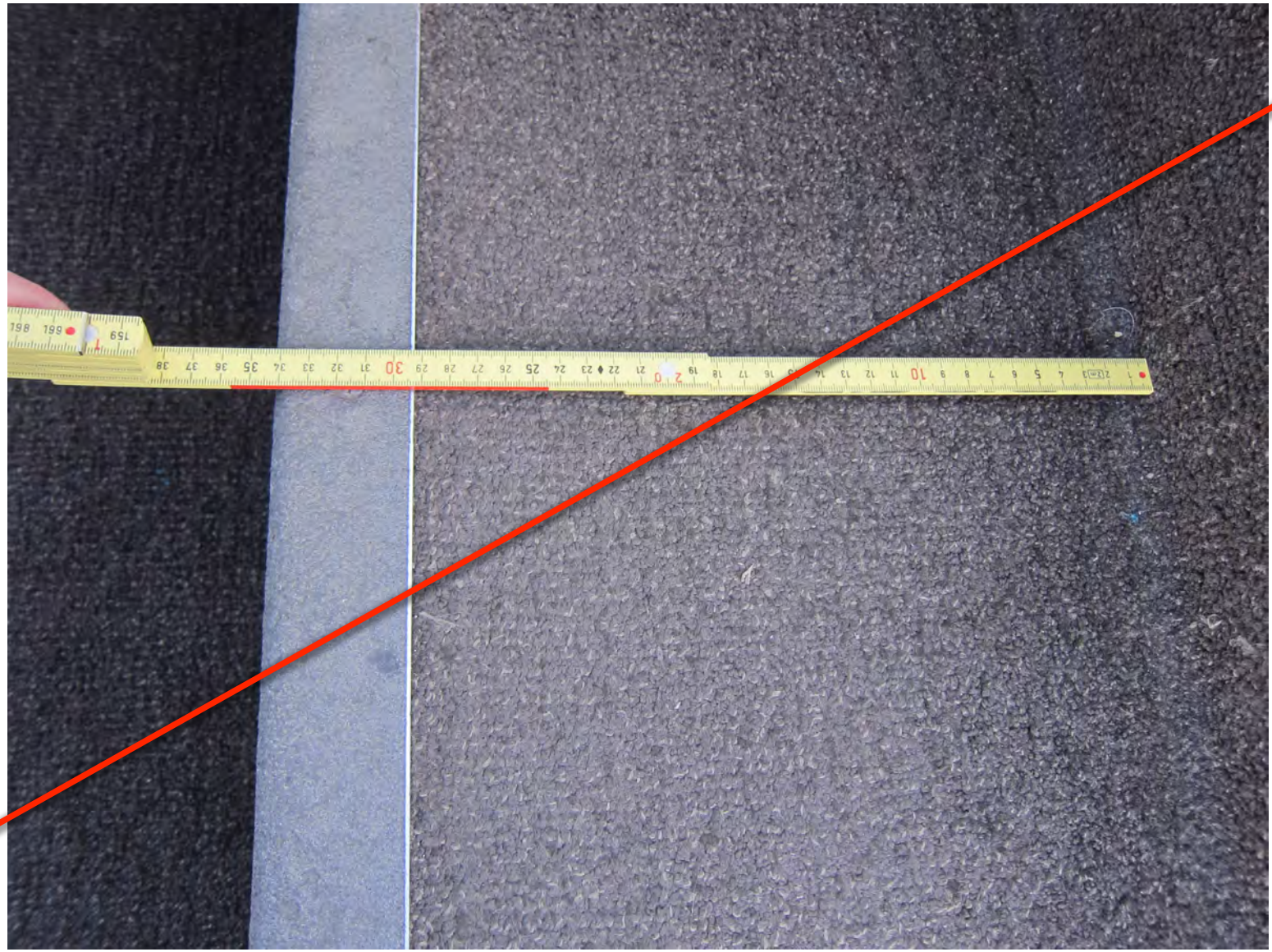
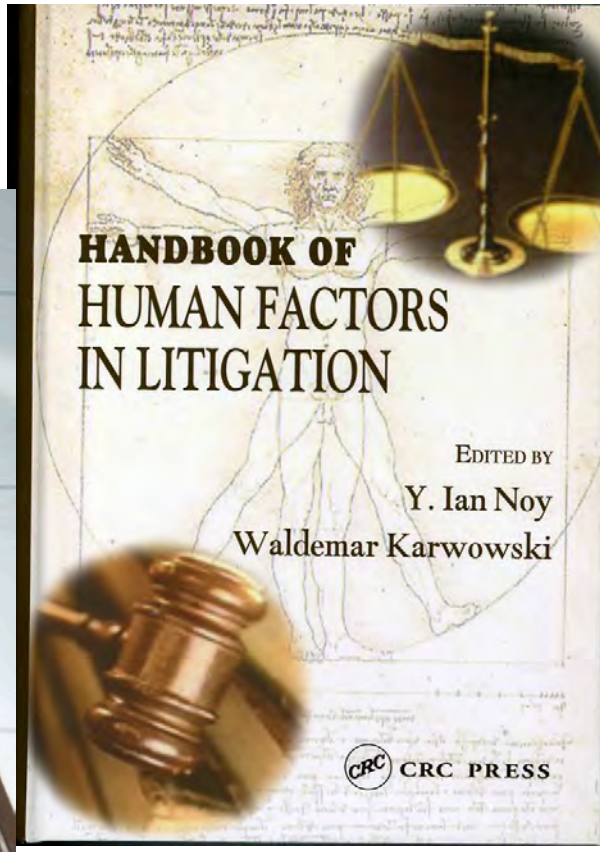



CRAFTSMAN


HANDBOOK OF
HUMAN FACTORS
IN LITIGATION
EDITED BY
Y. Ian Noy
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CRC PRESS


TiltMeter
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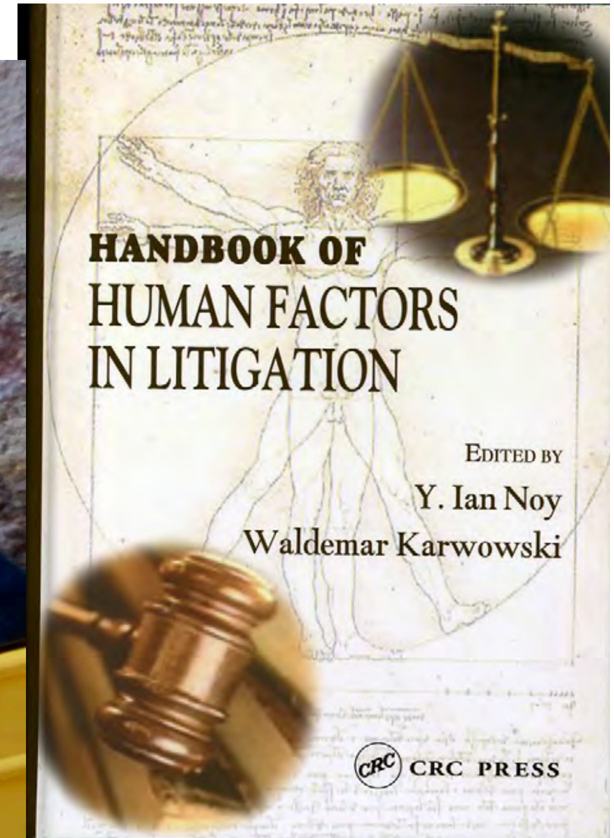
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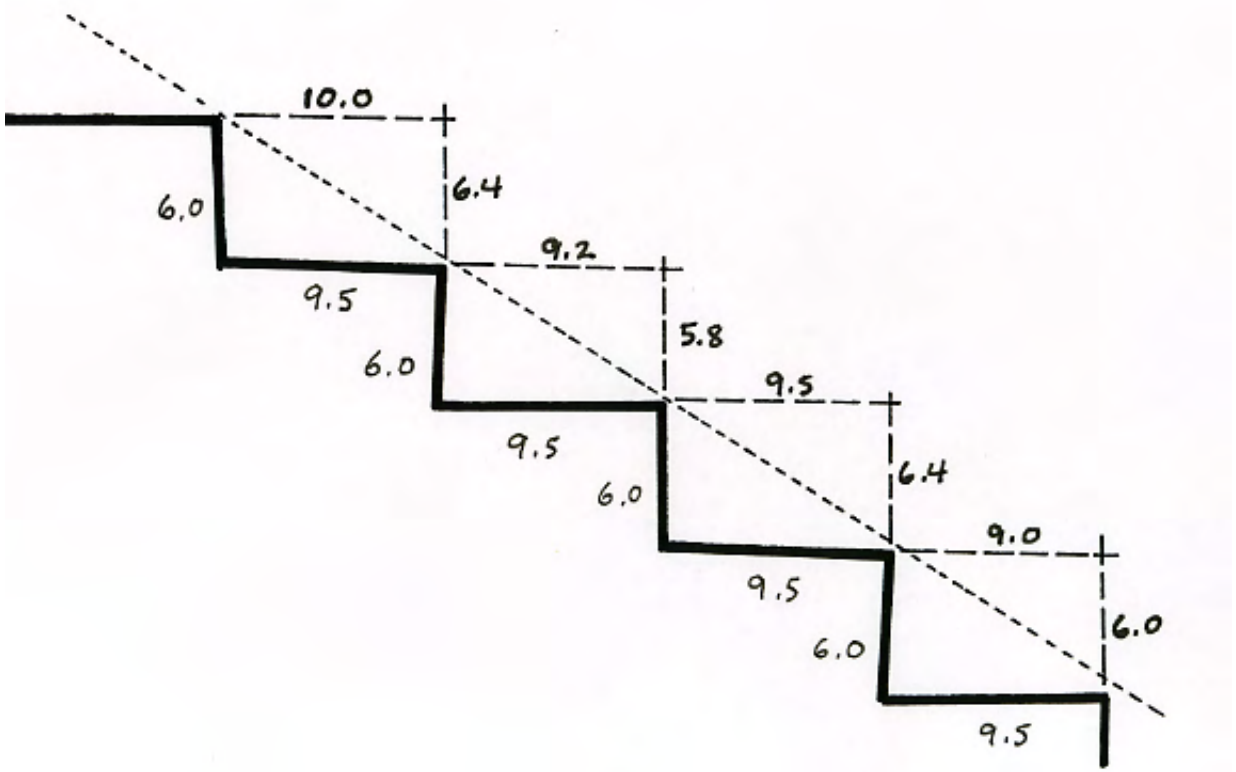
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But "Crouch and Sight" Test May Not Detect This Flaw

Graphic from NBC "Today Show" video

- Rarely, the nosings may line up, but the runs could still be non-uniform
- To rule this out, also measure A & B after doing Crouch and Sight Test.

Top Of Flight Flaw (TOFF)
and other systemic or random nonuniformities in the dimensions of a stair rise and run are building code violations.

Top Of Flight Flaw (TOFF) and other systemic or random nonuniformities in the dimensions of a stair rise and run are building code violations, but officials and inspectors are doing a poor job in checking for flaws and requiring remedial measures.

Top Of Flight Flaw (TOFF) and other systemic or random nonuniformities in the dimensions of a stair rise and run are building code violations. *Nonuniformities greatly increase ones risk of a misstep and fall during stair use* ***—by factors of 10, 30, or more***

Table 2. Estimated relative annual risks per 100,000 population, of US hospital emergency department visits for home stair-related falls with various nominal run (going) dimensions and with various occurrences of Top of Flight Flaw (TOFF) non-uniformity

Uniformity condition: Percentage of stairs with TOFF	**Annual injurious fall risk rates with various nominal tread runs** Risk rates shown are per 100,0000 population				
	190 mm Effective run with carpet	**210 mm** Used in codes in Canada	**230 mm** Favoured by US home builders	**250 mm** Minimum in ICC codes	**280 mm** Minimum in NFPA codes
0	230	140	110	50	20

Risk Increase due to nominal—*uniform*—run dimensions

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2	250	150	120	62	**32 (Ref)**

Risk With Top Of Flight Flaw

Risk Increase due to nominal—*uniform*—run dimensions

Table 2. Estimated relative annual risks per 100,000 population, of US hospital emergency department visits for home stair-related falls with various nominal run (going) dimensions and with various occurrences of Top of Flight Flaw (TOFF) non-uniformity

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	190 mm Effective run with carpet	**210 mm** Used in codes in Canada	**230 mm** Favoured by US home builders	**250 mm** Minimum in ICC codes	**280 mm** Minimum in NFPA codes
0	230	140	110	50	20
2	250	150	120	62	**32 (Ref)**
5	260	170	140	80	50
10	290	200	170	110	80
15	**320 (10 x Ref)**	230	200	140	110
20	350	260	230	170	140
25	380	290	260	200	170
30	410	**320 (10 x Ref)**	290	230	200
35	440	350	**320 (10 x Ref)**	260	230
40	470	380	350	209	260
45	500	410	380	**320 (10 x Ref)**	290
50	530	440	410	350	**320 (10 x Ref)**
55	560	470	440	380	350
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100					**633**

Small-sample, New Home Checks in Ontario, Alberta and BC

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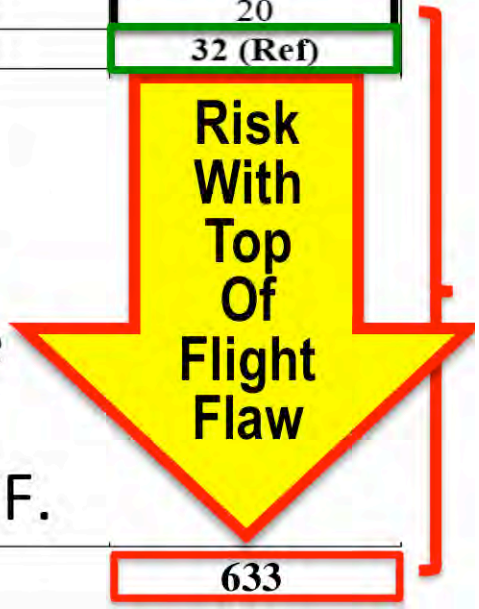
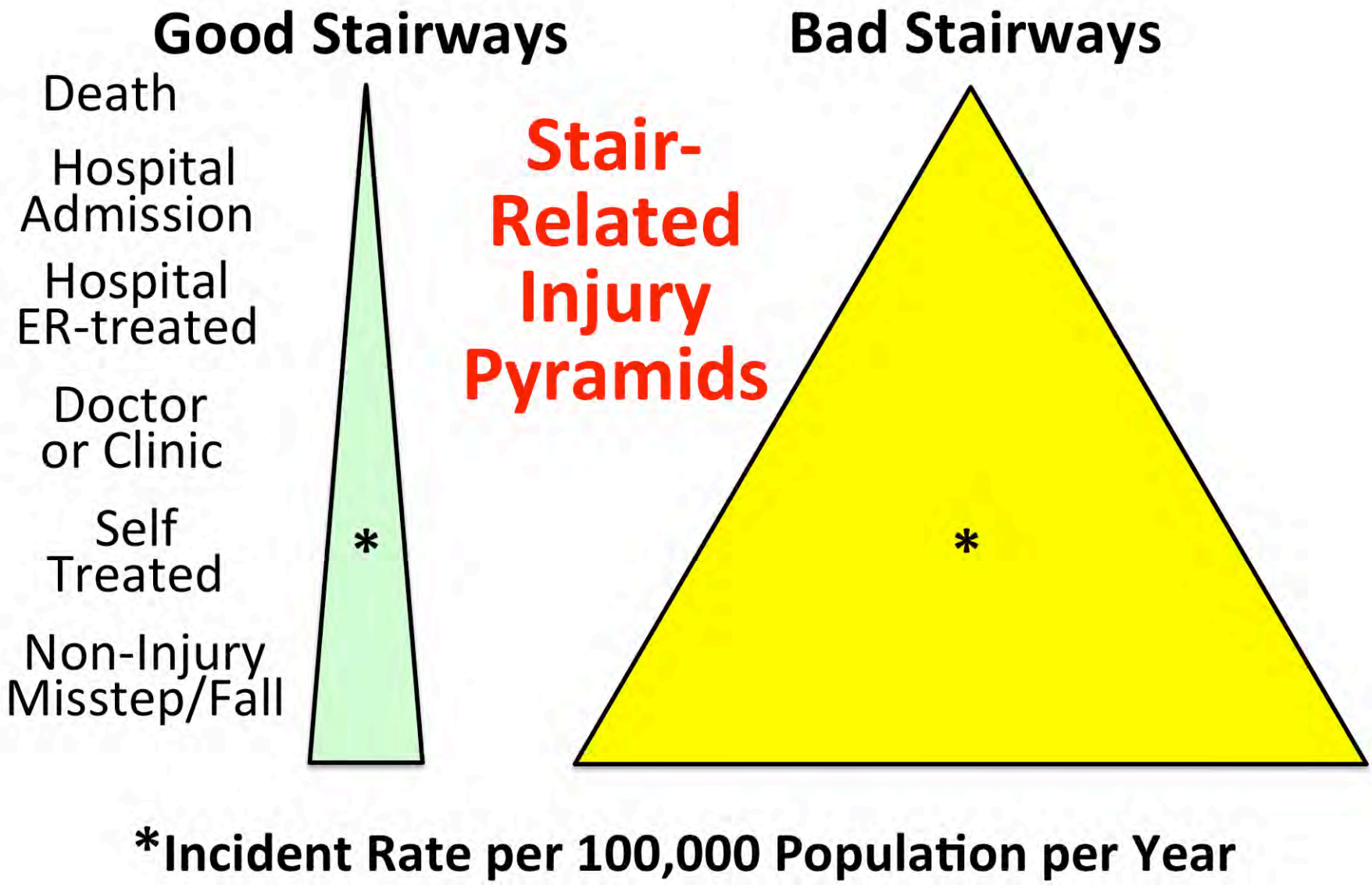
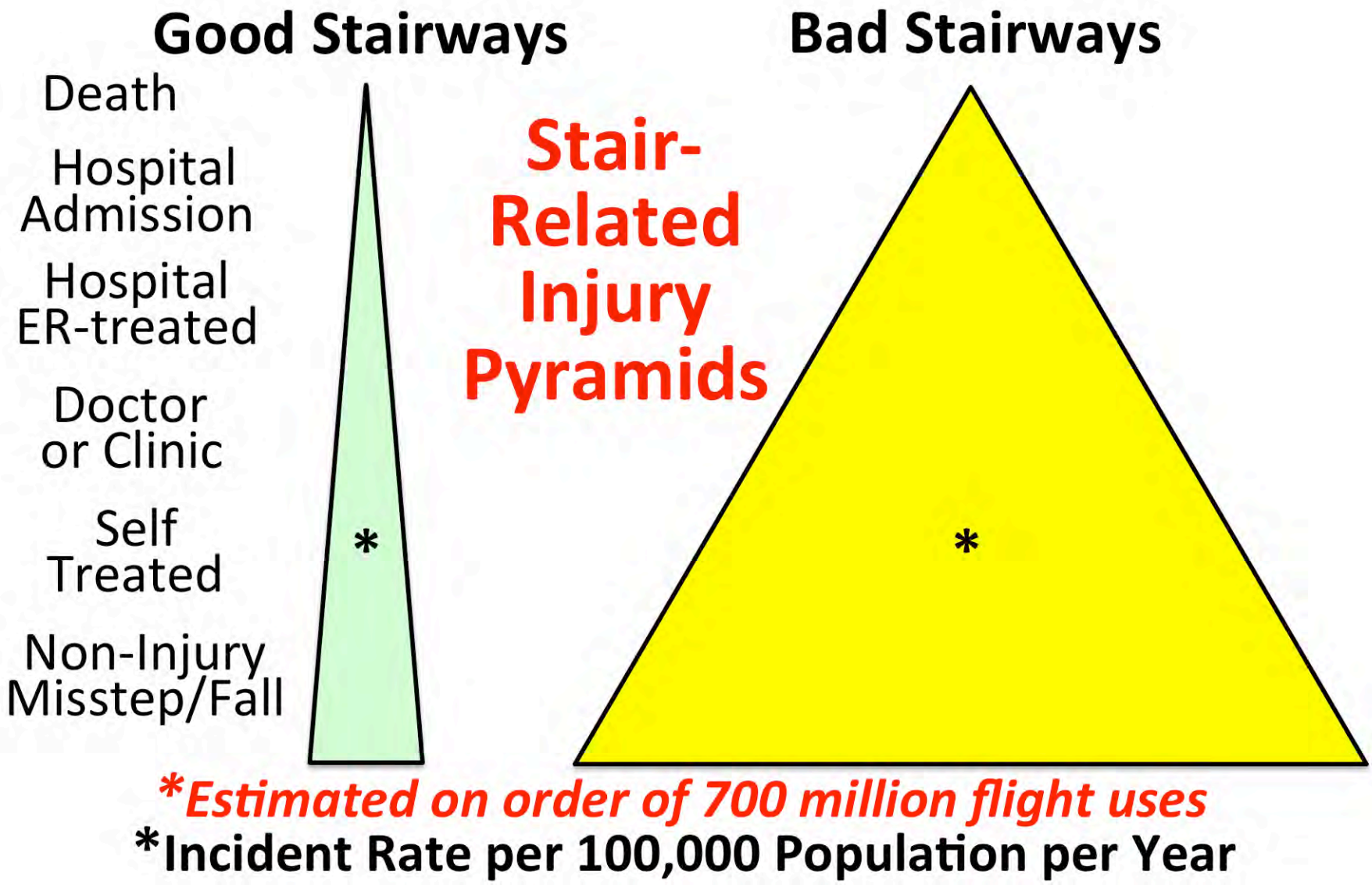
100%					**633**

For purposes of this Table, it is assumed that Top OF Flight Flaw (TOFF) increases risk of a fall-related injury on a stair by a factor of about 30 beyond other risks due to step dimensions. Further research is needed to determine actual risk with TOFF.




Good Stairways
Bad Stairways
Stair-Related Injury Pyramids
Death
Hospital Admission
Hospital ER-treated
Doctor or Clinic
Self Treated
Non-Injury Misstep/Fall
*
*
*Incident Rate per 100,000 Population per Year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*Estimated on order of 700 million flight uses
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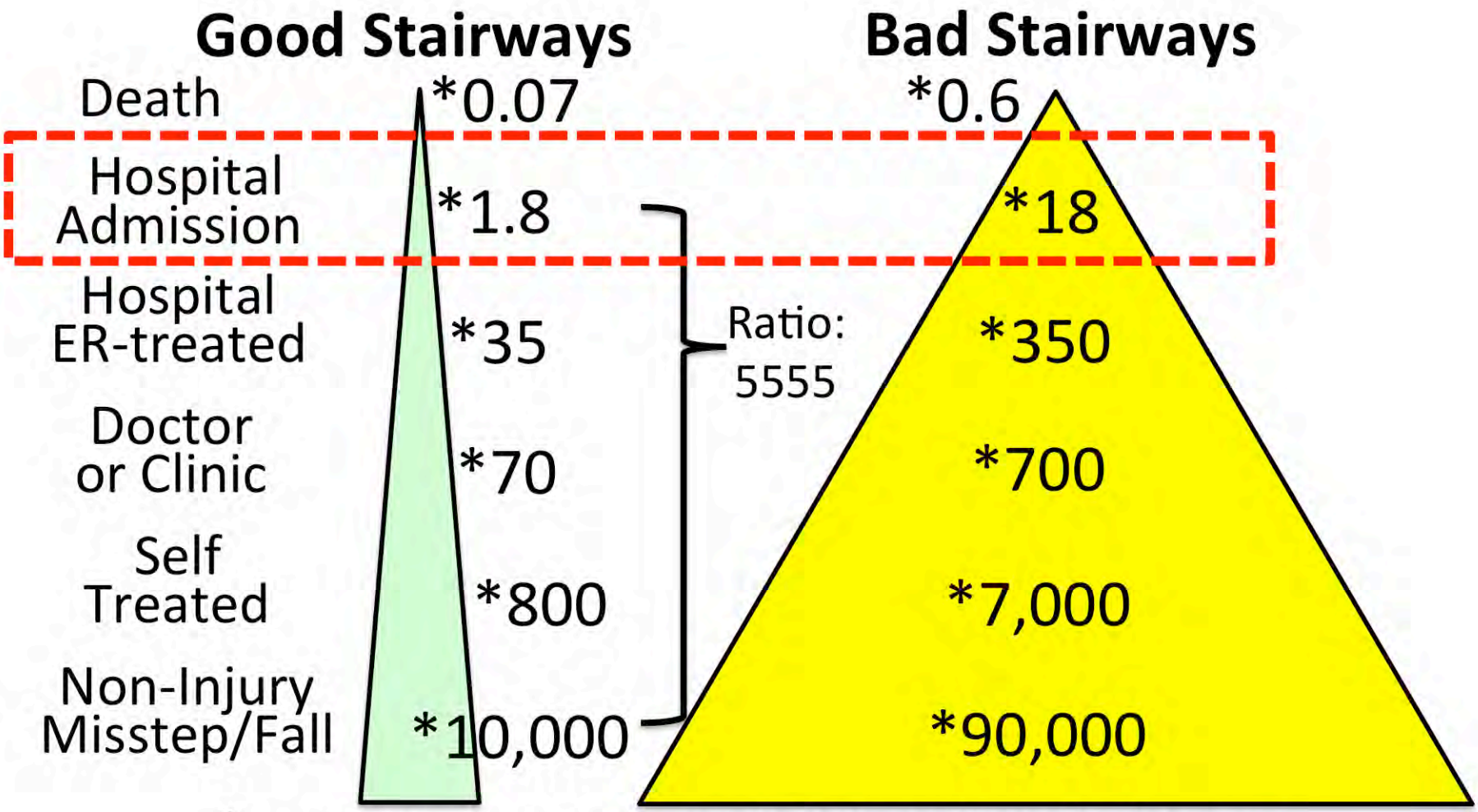

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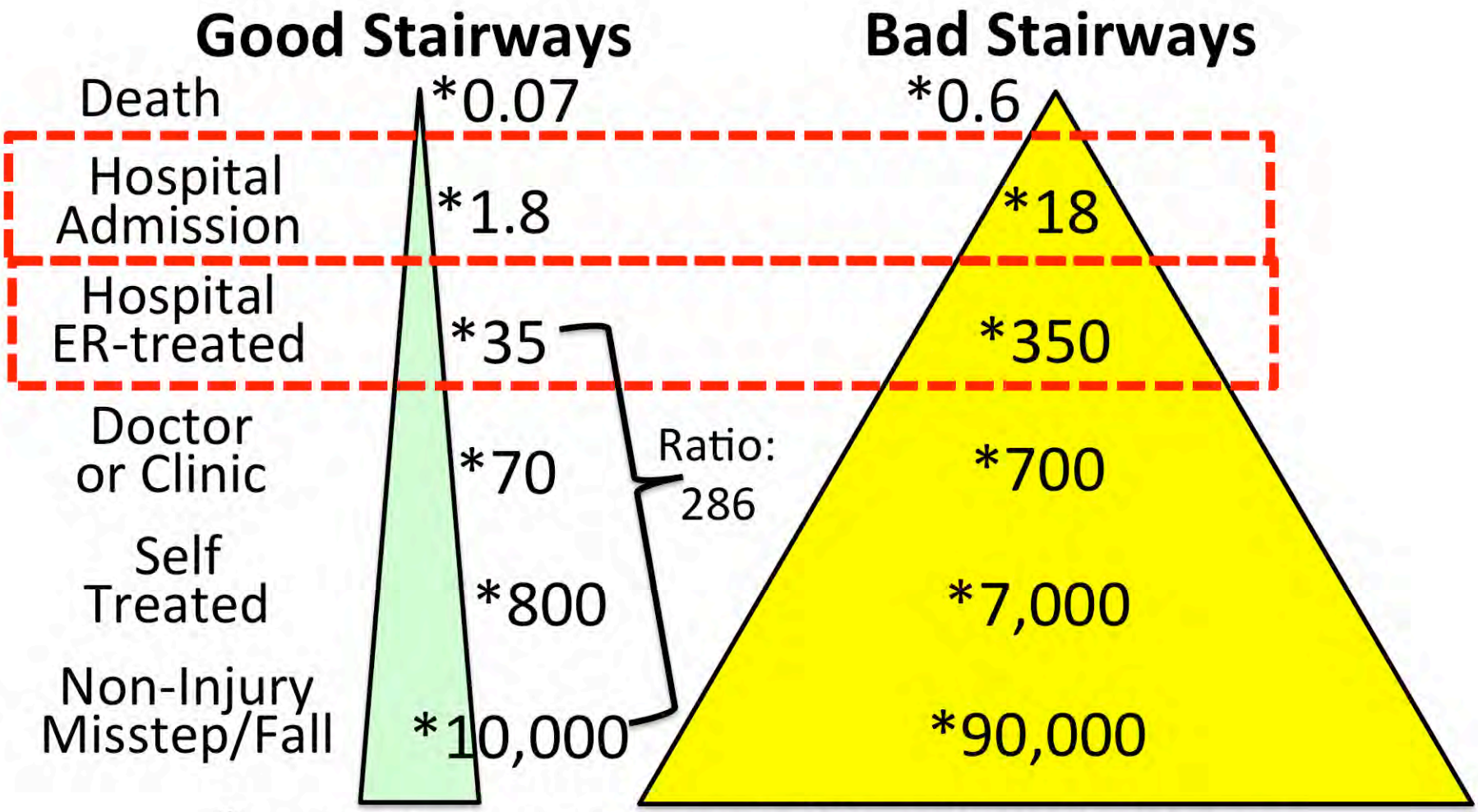
***Incident Rate per 100,000 Population per Year**



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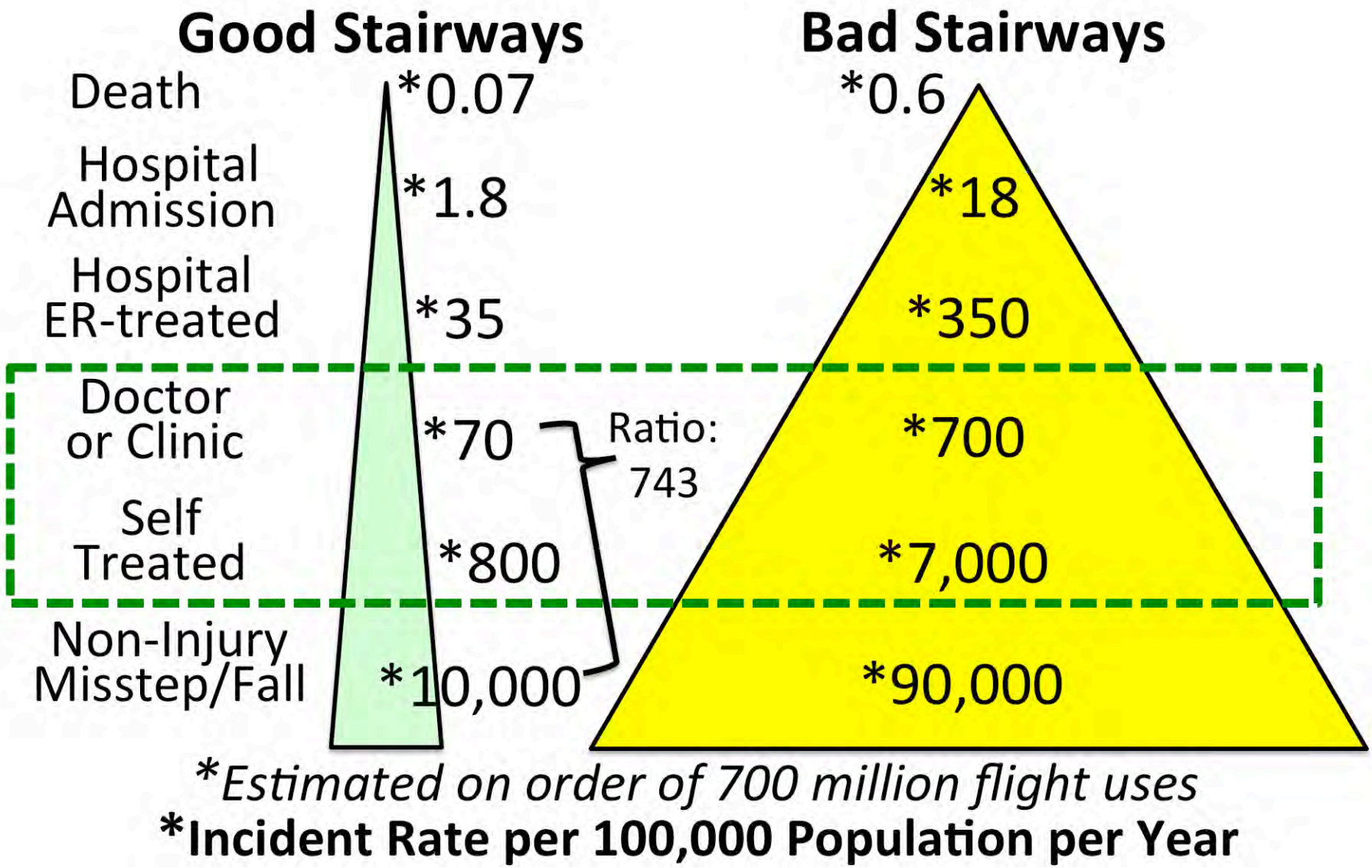

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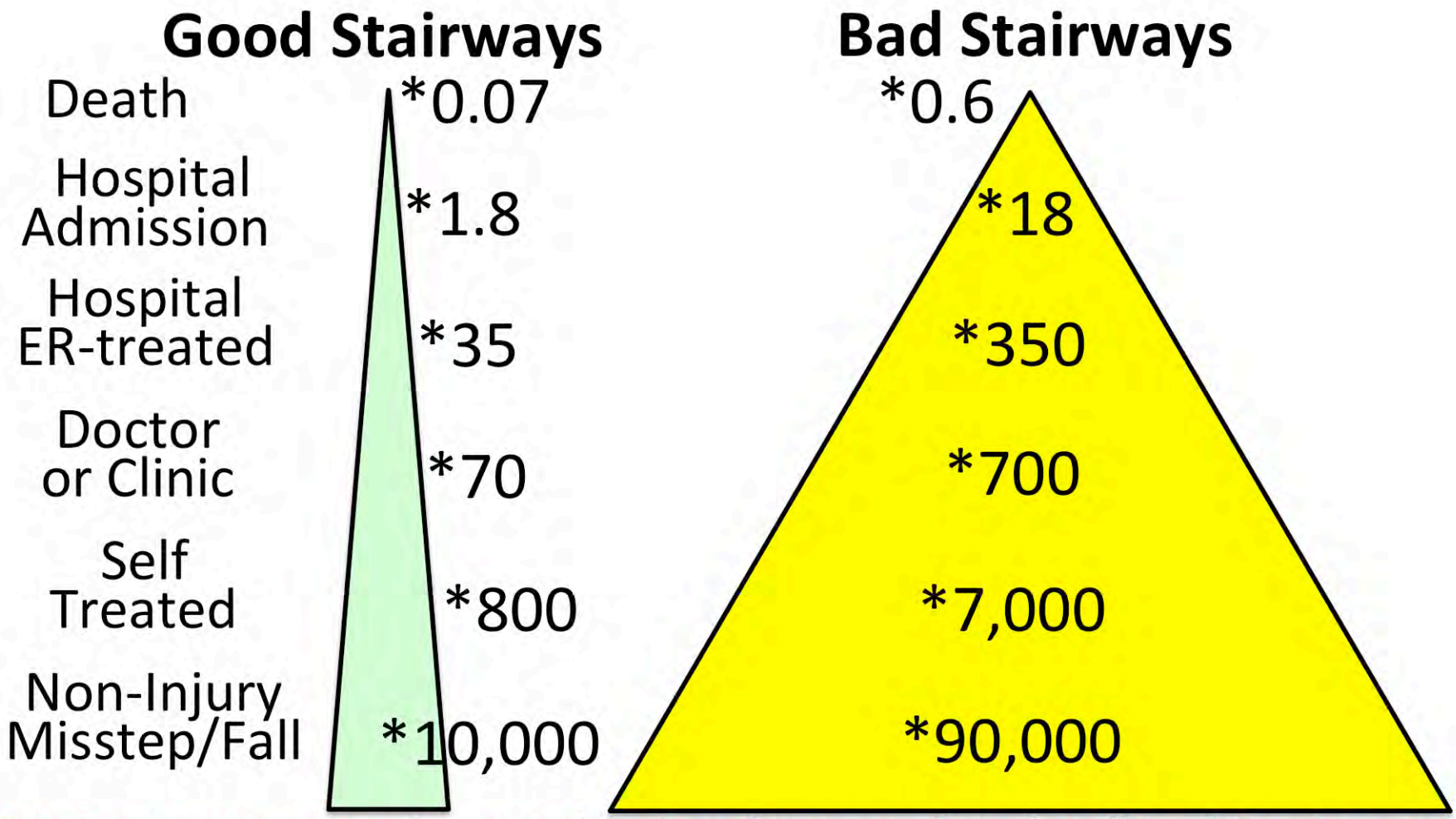
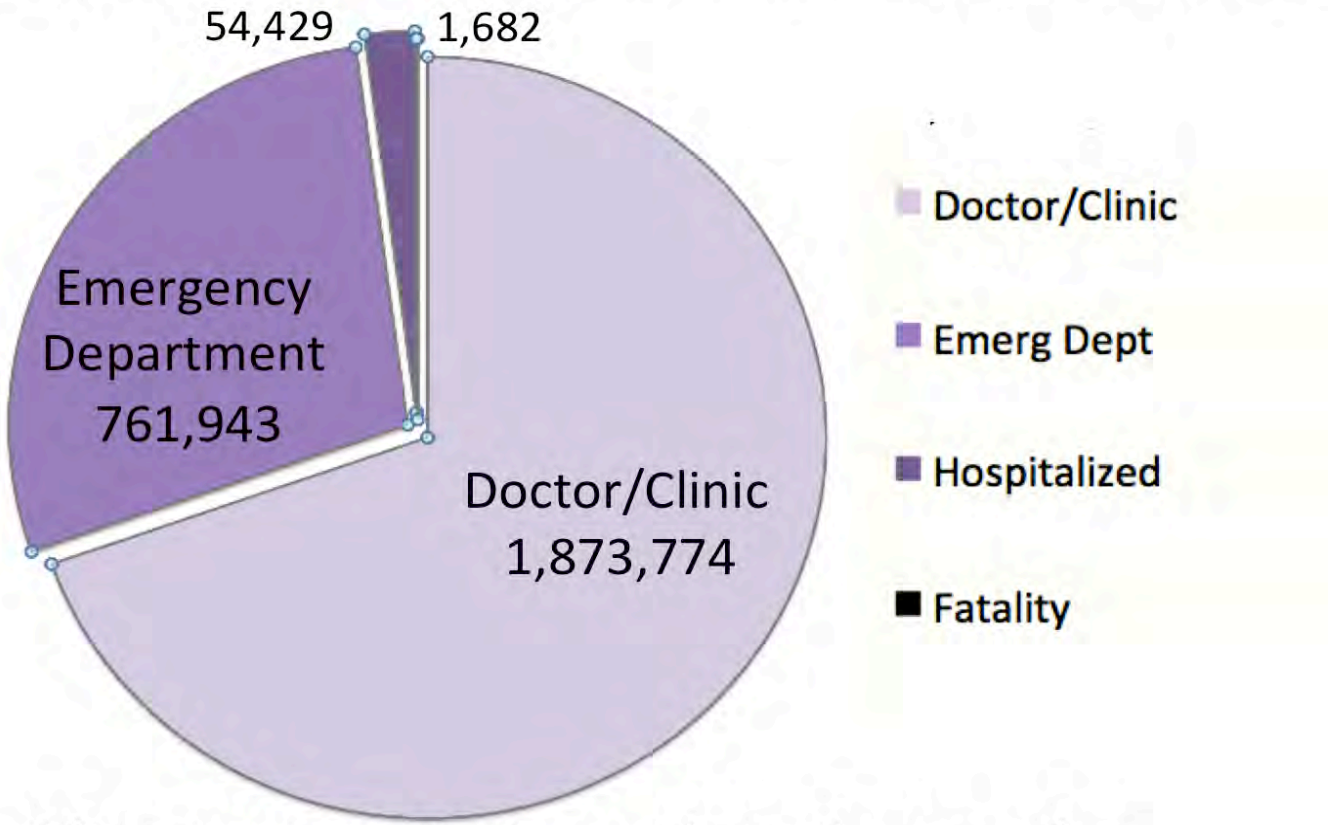


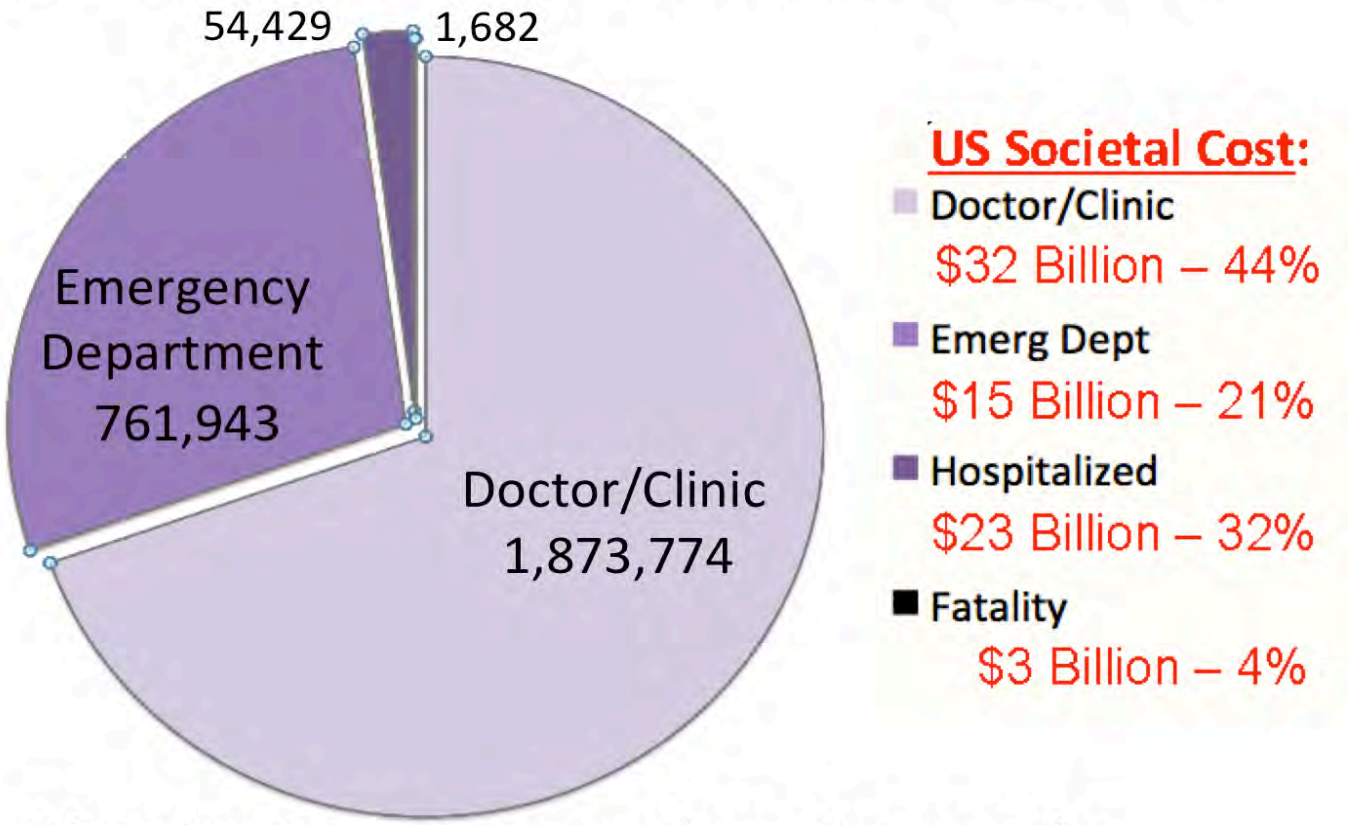
Major causes and contributing factors for the "Bad Stairway" pyramid were identified long ago; e.g. step dimensions.

US Home Stair Injury Treatment Data from Ted Miller, PhD, 2011



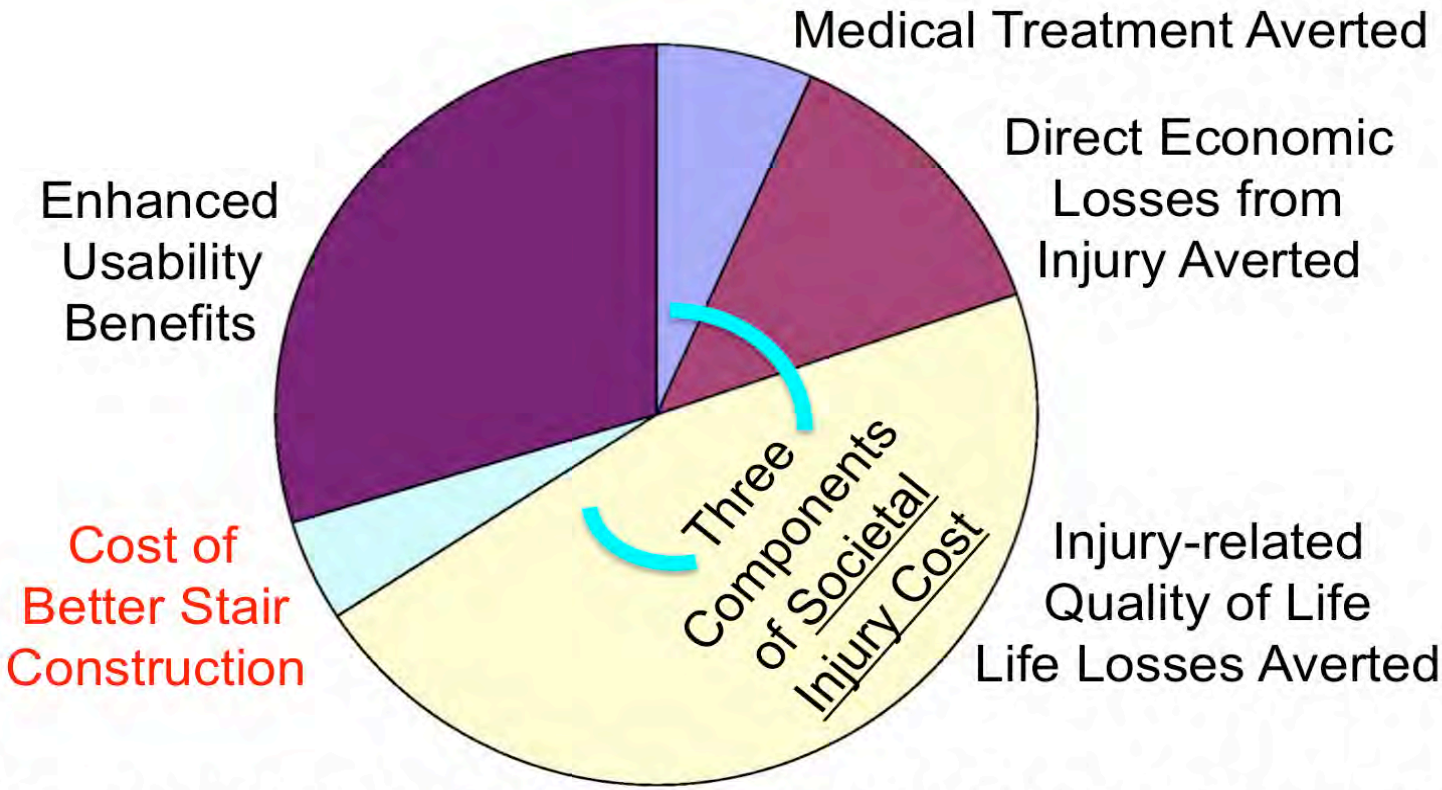
Place of first treatment—in number of cases—for 2.7 million US home stair-related injuries in 2007

US Home Stair Injury Cost Data from Ted Miller, PhD, 2011



Place of first treatment—in number of cases—for 2.7 million US home stair-related injuries in 2007

(With societal costs, totaling $72 Billion, shown with key to chart)



Multiple, Improved-Stair Benefits—*Beyond Medical Treatment Averted*—Greatly Exceed Cost of Better Stair Construction

(According to Jake Pauls' Benefit-Cost Analysis, 2002)
Entire circle represents on order of US$180 Billion in Year 2015 in USA

Societal costs of non-fatal, stair-related injuries are based largely from the work of a few researchers in the USA, especially BA Lawrence and TR Miller, 2000 & (with RS Spicer) 2015.*

Injury Control & Safety Promotion
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Injury Control & Safety Promotion – 2000,
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Accepted 5 January 2000

Estimating the costs of non-fatal consumer product injuries in the United States

Bruce A. Lawrence, Ph.D.[1]
Ted R. Miller, Ph.D.[1]
Alan F. Jensen, J.D., M.A.[1]
Deborah A. Fisher, Ph.D.[1]
William W. Zamula, M.A.[2]

[1]Pacific Institute for Research and Evaluation, Landover, MD and [2]US Consumer Product Safety Commission, Washington, DC

Abstract This paper describes a data-driven injury cost model (ICM) developed to estimate the costs associated with non-fatal consumer product injuries. The modeling effort combines information by diagnosis from the US Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS) and 17 other large data sets. The ICM contains four aggregated cost components: (1) medical costs, (2) work losses, (3) quality of life and pain and suffering costs, and (4) product liability insurance administration and litigation costs. The ICM estimates societal costs, which are broader than costs to any individual group, such as victims, insurers, or product manufacturers.

Costs associated with consumer product injuries are estimated to be approximately $500 billion in 1996, accounting for nearly one-third of the total annual injury costs. We examine injury costs in several ways,

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Acknowledgements:
The opinions expressed in this article

Original article

A fresh look at the costs of non-fatal consumer product injuries

Bruce A Lawrence, Rebecca S Spicer, Ted R Miller

Pacific Institute for Research and Evaluation, Calverton, Maryland, USA

ABSTRACT

Background Products under the purview of the Consumer Product Safety Commission are involved in a large share of injuries and injury costs in the USA.

Methods This study analyses incidence data from the National Electronic Injury Surveillance System (NEISS) and cost data based on the Injury Cost Model, integrated with the NEISS. We examined the magnitude of non-fatal consumer product related injury, the distribution of products involved in these injuries and the cost of these injuries. We compared these findings with an earlier identical study from 2000.

Results In 2008–2010, 43.8% of the annual 30.4 million non-fatal injuries treated in hospital emergency departments involved consumer products. Of these consumer product related injuries, in 2009–2010, just three product groups accounted for 77% of the $909 billion annual cost: sports and recreation; home structures and construction materials; and home furnishings and fixtures. Sports and recreation was a leading cause of injury costs among 5–24-year-olds, particularly football, basketball, bicycling, baseball/softball and soccer. Since 1996, football surpassed basketball in becoming the number one cause of injury costs for children aged 10–19 years and the fifth ranked cause of product related injury costs overall. Among those over age 30 years, stairs and floors were a leading cause of consumer product related injury costs, in particular among those over age 70 years where they were responsible for over one-fifth of costs.

Conclusions The findings of this study highlight priority areas for intervention and generate questions for future research.

these injuries.[1] While incidence data are useful for assessing the magnitude of the problem, costs better account for multiple injury consequences—death, severity, disability, body region, nature of injury—in a single unit of measurement. Cost analyses are useful for comparing injury causes, assessing related health burden, setting priorities and planning cost effective prevention strategies.

Previously, using 1995–1996 NEISS data, Lawrence *et al*[1] developed and used the ICM to estimate the costs associated with non-fatal injuries related to products under CPSC jurisdiction. They found that consumer product injuries cost approximately $500 billion per year in 1995–1996, accounting for nearly one-third of injury costs in the USA.

This aim of this article was to update these estimates of consumer product injury costs by applying the ICM to NEISS data from 2009 to 2010. We further examined the leading products responsible for non-fatal injury costs in 2009–2010 compared with 1995–1996.

METHODS

NEISS is a weighted national probability sample of consumer product related injury visits to EDs in a sample of 100 US hospitals. Overall, NEISS includes data on approximately 400 000 ED injury visits per year. The NEISS data provided detailed information on consumer product related injuries.

Since 2000, 66 of the 100 NEISS hospitals have participated in an expanded collection effort that covers all injuries, not just those involving con-

* See *Inj Prev* 2015:**21**:23-29

Societal costs of non-fatal, stair-related injuries are based largely from the work of a few researchers in the USA, especially BA Lawrence and TR Miller, 2000 & (with RS Spicer) 2015.*

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A fresh look at the costs of non-fatal consumer product injuries

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Stair-related Injury Cost: $92 Billion in 2009

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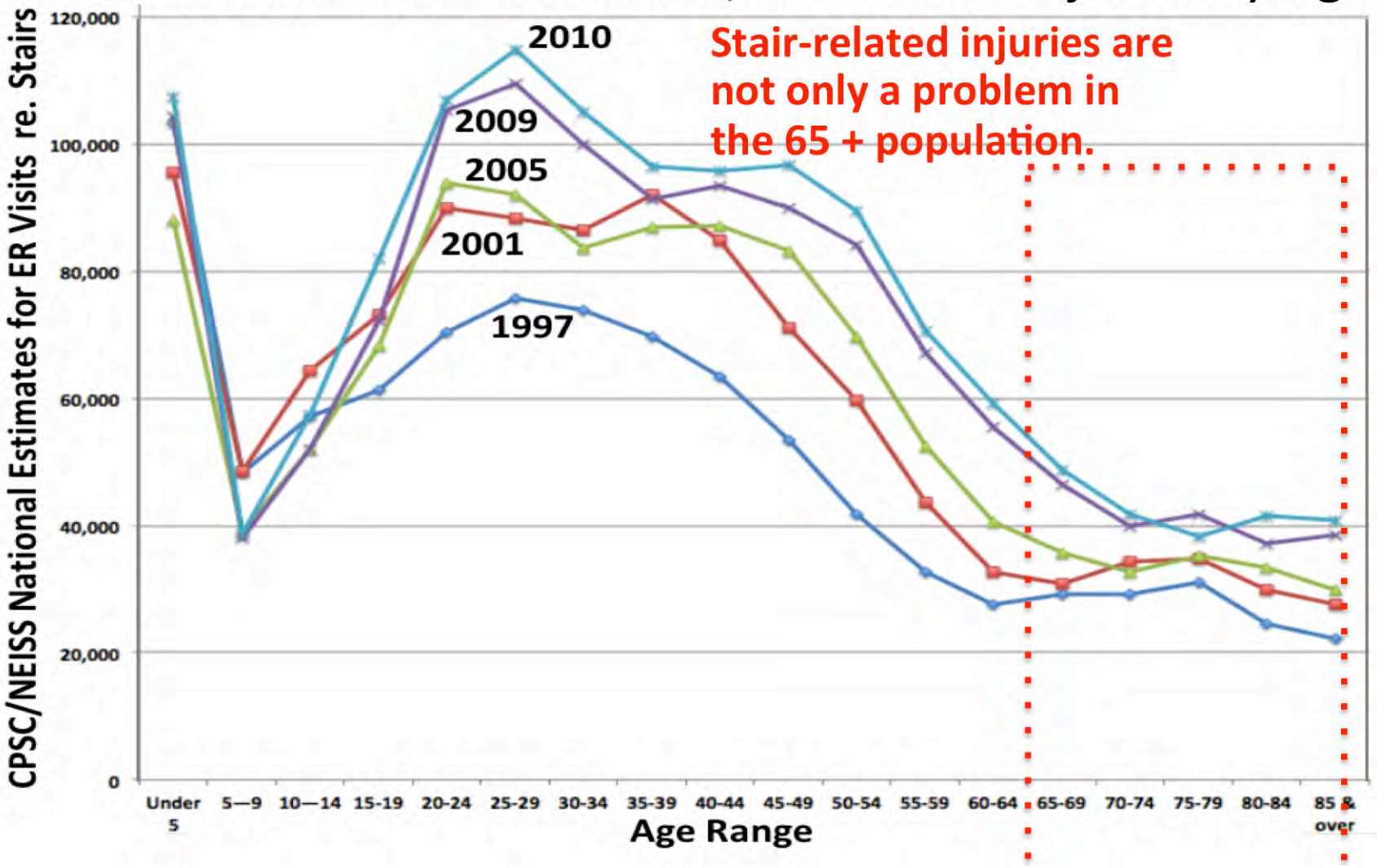
Stair-related Injury Cost: $49 Billion in 1996

* See *Inj Prev* 2015:**21**:23-29

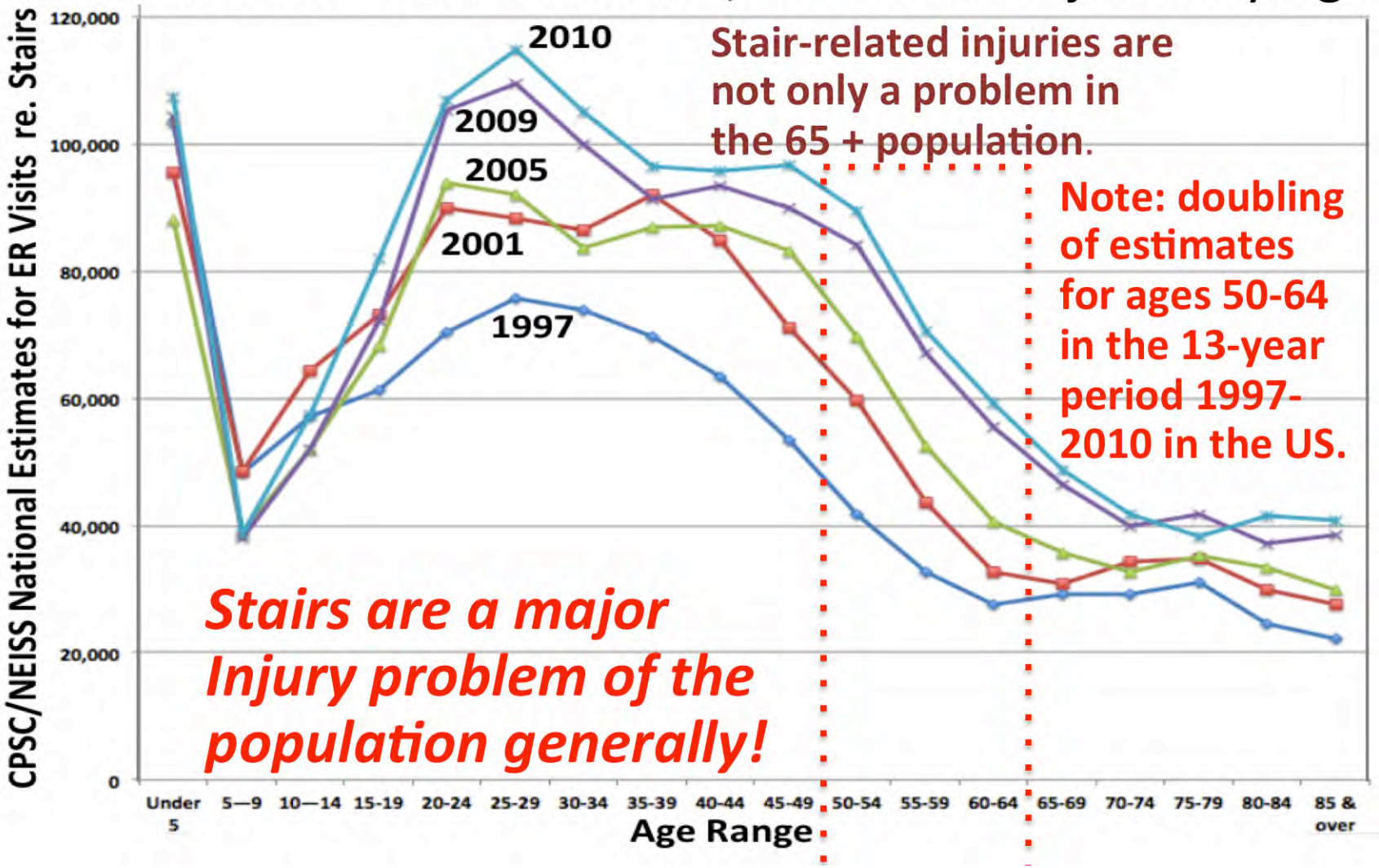
Increase in US Stair-related, ER-treated Injuries by Age

Stair-related injuries are not only a problem in the 65 + population.

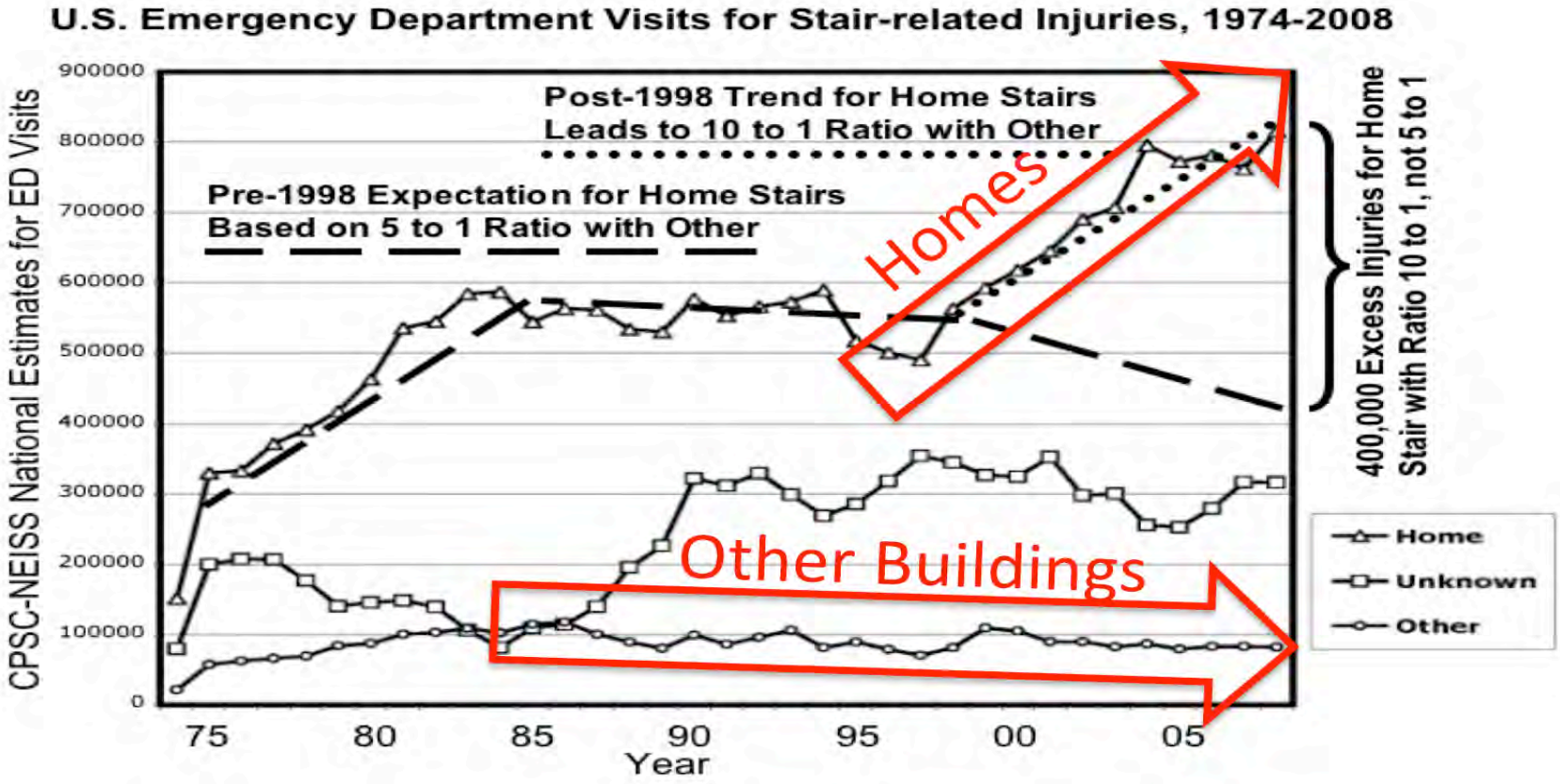
Increase in US Stair-related, ER-treated Injuries by Age



Increase in US Stair-related, ER-treated Injuries by Age



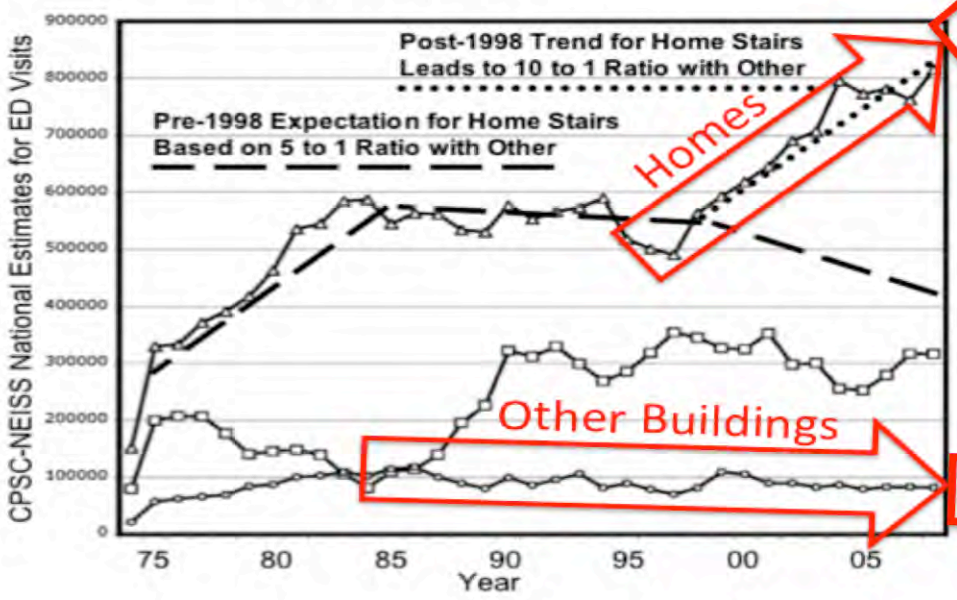
The pattern of predictable, preventable injury tolls persists and grows. Here is the pattern in recent decades in the USA (shown here because comparable data for Canada are lacking).

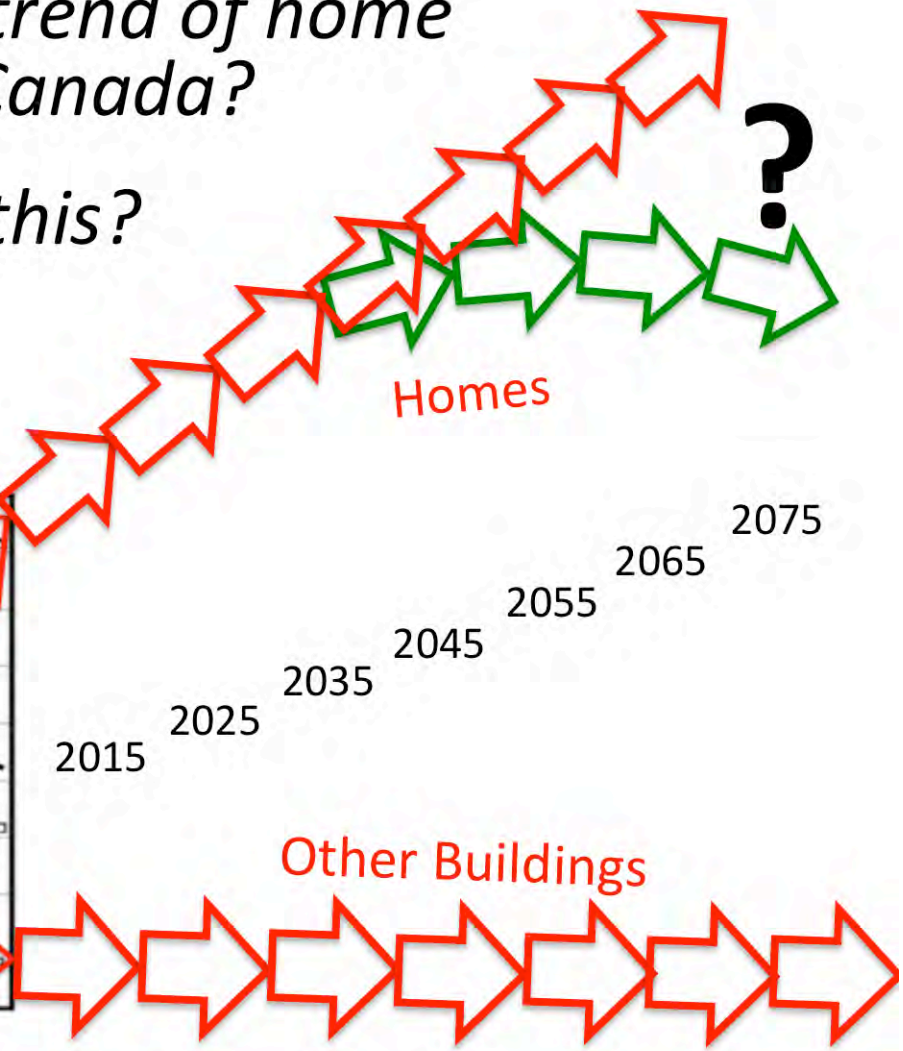


What will be the future trend of home stair-related injuries in Canada?

What will contribute to this?

What roles will public health have?





International Symposium on Forensic Science Error Management, July 21-24, 2015

Thank You

Jake Pauls
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