MODERNIZING PUBLIC WARNING MESSAGING

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ACKNOWLEDGEMENTS

- **USACE**
  - **Risk Management Center, Davis, CA**
- **FEMA**
  - **IPAWS/WEA Review Subcommittee**
- **USDHS**
  - **Science & Technology Directorate**

MY PERSONAL ALERT & WARNING EXPERIENCE

- **Research**
  - **1972 Rapid City Flood; 1982 Nevado del Ruiz Volcano; 2001 World Trade Center; 2017 Oroville Dam**
- **Applications**
  - **1979 Three Mile Island; 1984 South American Volcanologists; 2014 DHS WEA Messaging; 2018 FEMA National Advisory IPAWS Subcommittee**
- **Litigation**
  - **2007 St. Rita's Nursing Home; 2009 Black Saturday Australian Bush Fires; 2011 Virginia Tech Shootings; 2018 Hollywood Hills Nursing Home**

THE RESEARCH RECORD

- **65 Years Long (varied disciplines)**
- **Varied Protocols/Locations/Events**
  - **Representative sample surveys (many)**
  - **Laboratory experiments (some)**
  - **U.S. & 13+ other countries**
- **Diverse Alert & Warning Topics**
  - ***Decision making* by alert & warning originators**
  - ***Warning diffusion* & audience penetration**
  - ***Public response* (about 125 publications)**

RESEARCH TO APPLICATION

- **One Study On One Event Yields**
  - **Case-event findings = observations**
    - **Not application ready because *"findings"* may not generalize to other events**
- **Many Studies Across Many Events**
  - **Repetitive findings = knowledge**
    - **Application ready because *"knowledge" generalizes across events***

ALERT ORIGINATORS

(10,000s of them in the U.S.)

- **Local Jurisdictions**
  - **Incident commanders (sheriffs & police chiefs)**
  - **Politicians, information officers, emergency managers**
- **Federal Agencies**
  - **NOAA & USGS**
- **Media**
  - **TV & radio broadcasters**
- **Private & Quasi-Public Sectors**
  - **Facility owners & operators, private alert service providers, university & school administrators**

WHAT THEY WARN ABOUT

- **Climatological**
  - **Fire, flood, mudslide, tornado, more**
- **Geological**
  - **Volcano, tsunami, more**
- **Terrorism**
  - **Biological, chemical, active shooter, more**
- **Technological**
  - **Dam failure, hazardous materials, more**

HISTORICAL OBSERVATION

- **Despite Variations In Event, Threat, Protective Action, Location, Culture**
  - **The *factors & processes* that influence human alert & warning behavior remain pretty much the same**
  - **But *how* people behave in any particular event can vary**

CURRENT OBSERVATION

- **A Gap Exists Between Advances In Public Warning Science & Practice**
  - **Filling the gap by modernizing public alerts & warnings would help maximize public health & safety**

ANSWER THE QUESTION

If I had the chance to address people who might one day be an alert originator, what 5 things would I tell them about modernizing public alerts & warnings in America?

1. FOCUS FIRST ON ALERTS AND WARNINGS FOR

- **Imminent (Rapid Onset) Events**
  - **Short *"detection to impact"* events**
  - **When detection to impact time is short (e.g., 1 to several hours) & warning delays have large public health & safety consequences**
  - **This is when alerts & warnings can provide the largest public good**

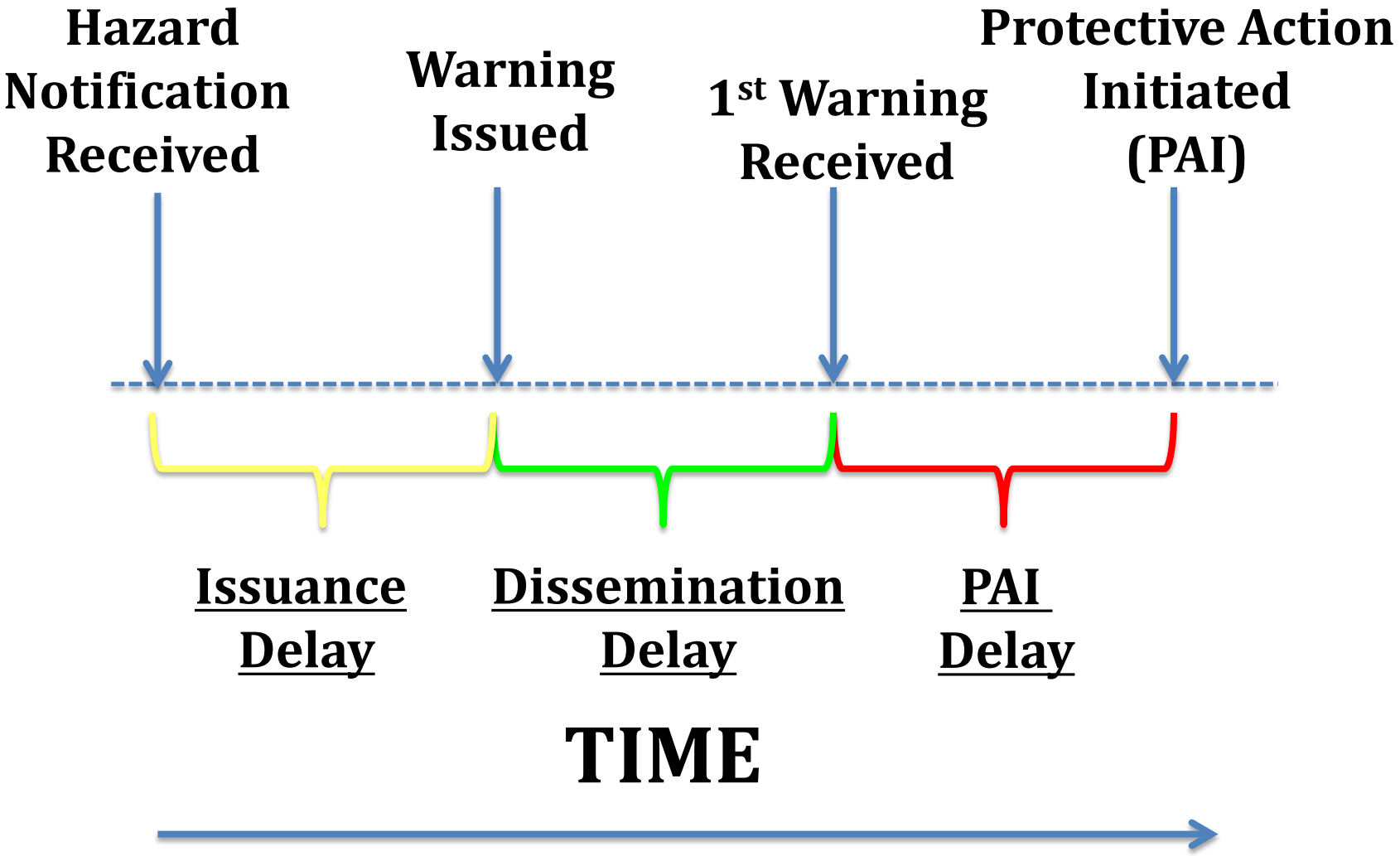
2. REMOVE DELAYS FROM THE SYSTEM

- ***DELAYS =*** ***anything that prolongs the time between threat event detection and public protective action initiation***

DELAY TYPES

- **3 Major Types of Delay in Public Alerts & Warnings**
  - **Warning *issuance* delay**
  - **Audience *dissemination* delay**
  - **Protective action initiation delay**
    - **Sometimes called *"compliance"***

DELAYS ARE ADDITIVE



3. PLANNING CAN REDUCE ISSUANCE DELAY

- **Warning Plans & Procedures**
  - **–Threat conditions**
  - **–Warning triggers**
  - **–Public protective actions**
- **Here's an Example……**

TABLE 3 - THREAT VS. PUBLIC ACTIONS FOR DAM BREACHES

PHYSICAL OBSERVATIONS*	THREAT LEVEL DESIGNATION	FLOOD THREAT	PROTECTIVE ACTION OPTIONS
Water flowing through breach in embankment	**LEVEL IV** Dam breaching or breached	Imminent or in progress	▯ Evacuate – vehicle ▯ Evacuate – pedestrian ▯ Evacuate – vertical ▯ Evacuate – safer structure ▯ Expedient protection of people ▯ Avoid area
Rapidly enlarging sinkhole	**LEVEL III** Dam breach very likely	Very likely	▯ Evacuate – vehicle ▯ Expedient protection of possessions ▯ Avoid area
New seepage areas with cloudy discharge or increasing flow rate	**LEVEL II** Conditions at dam may or may not lead to breach	Possible but not certain	▯ Expedient protection of possessions ▯ Seek or monitor information ▯ Prepare to evacuate
New seepage areas in or near the dam	**LEVEL I** Safety issues being investigated	Potential being determined	▯ Seek or monitor information

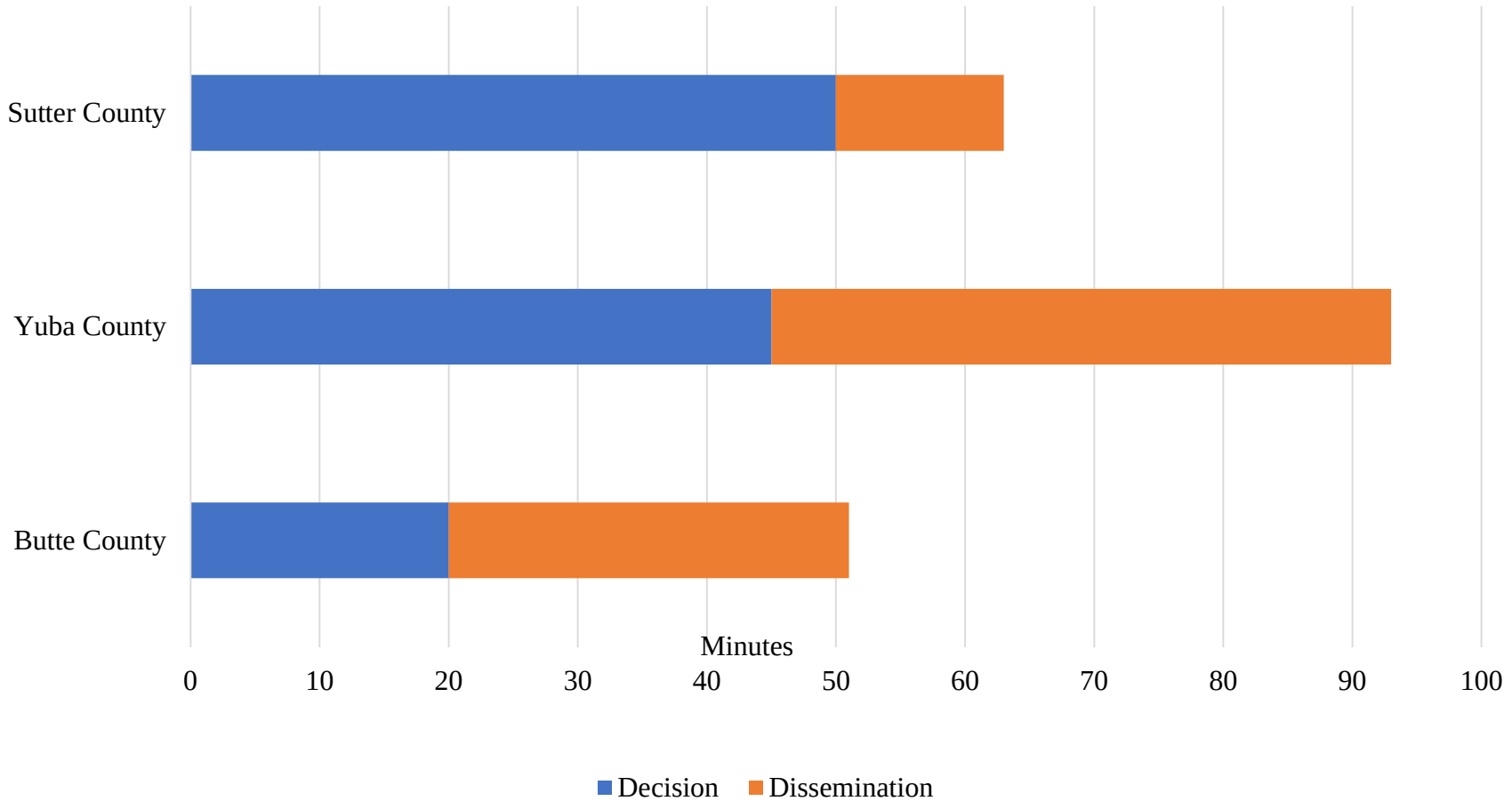
** This column contains examples of physical observations; these observations should be tailored to fit individual projects.*

PLANNING ALSO INCLUDES

- **Primary Factors, e.g.,**
  - **Written plan, rules & procedures, threat classes**
- **Secondary Factors, e.g.,**
  - **Identified responsibilities, legal authority, drills & exercises**
- **Tertiary Factors, e.g.,**
  - **Threat verification procedures, inter-agency contact information available**

WHAT ISSUANCE DELAY LOOKS LIKE

(Oroville Dam Event February 2017)



AN OBSERVATION

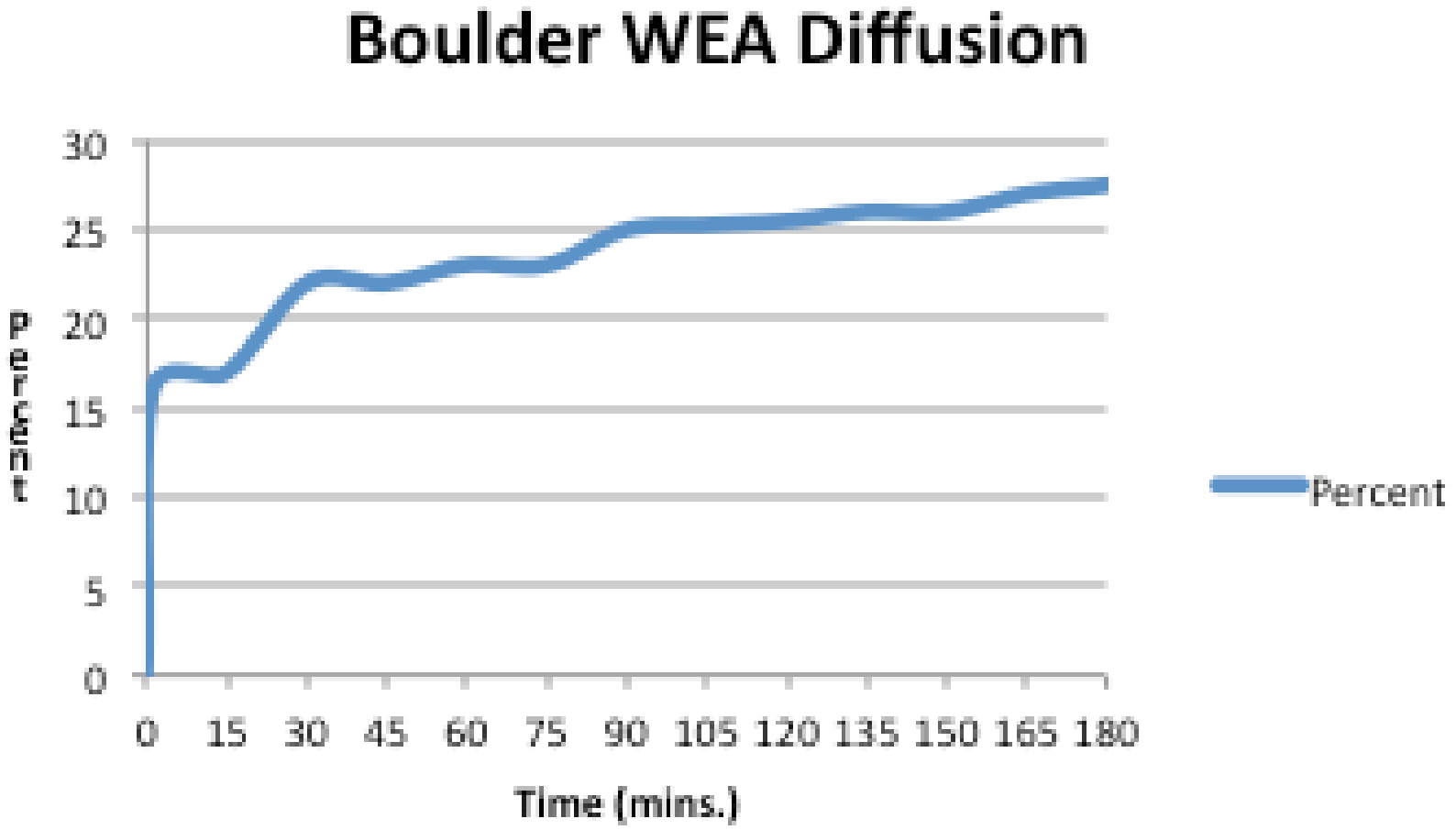
- **In General, At Least In America**
  - **Most alerts & warnings are *"ad hoc"***
  - **We have plans & procedures for *preparedness & response***
  - **But many jurisdictions lacks plans & procedures for *public warning***
    - **Note: emergency planning works, not planning doesn't work quite as well**

4. DISSEMINATE ALERT & WARNING MESSAGES WISELY

- ***There Is No Silver Bullet Warning Dissemination Technology***
- **Every Dissemination Channel Has Pros and Cons Including**
  - **Audience (receiver) factors**
  - **Technological (reach) factors**
  - **For example……..**

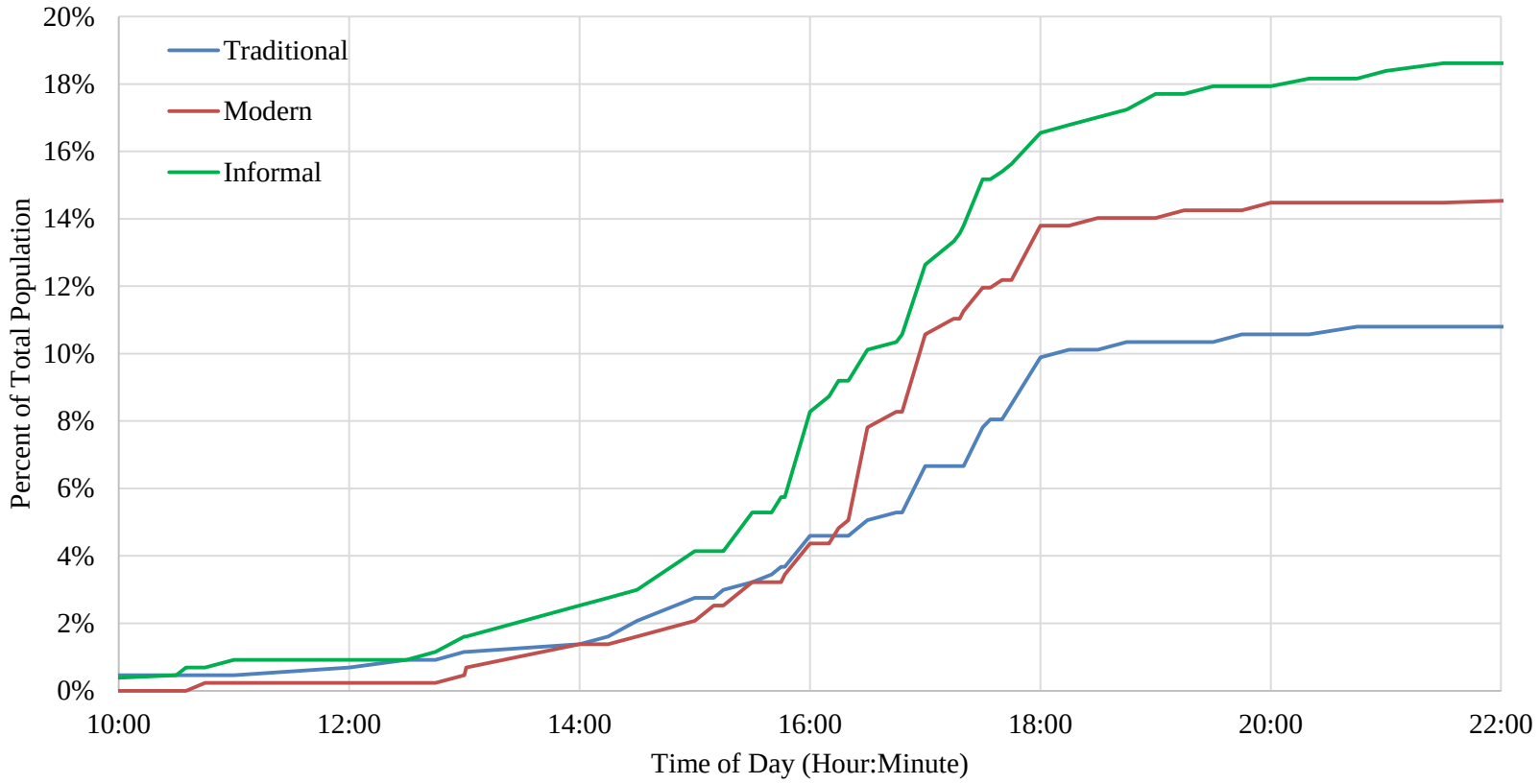
DISSEMINATION CHANNELS	SPEED[1]	COVERAGE[2]	CONCENTRATION[3]	MESSAGE COMPREHENSIVENESS[4]
Route alerting	Slow	Limited	Concentrated	High
Loudspeakers and public address (PA) systems	Fast	Limited	Concentrated	Medium
Wireless Emergency Alerts (WEA)	Very Fast	Widespread	Dispersed	Very Low
Wireless communications (SMS)	Very Fast	Widespread	Dispersed	Very Low
Radio	Moderately Fast	Widespread	Dispersed	High to Low
Television broadcast	Moderately Fast	Widespread	Dispersed	Very High to Medium
Television message scrolls	Moderately Fast	Widespread	Dispersed	Low
Newspaper	Very Slow	Widespread	Dispersed	Very High
Dedicated tone alert radios	Very Fast	Limited	Concentrated	High
Tone alert and NOAA Weather Radio	Fast	Widespread	Dispersed	High
Text Telephone (TDD/TTY)	Fast	Widespread	Dispersed	Low
Reverse telephone distribution systems	Fast	Limited	Dispersed	High
Audio sirens and alarms	Fast	Limited	Concentrated	Very Low
Broadcast sirens	Fast	Limited	Concentrated	Medium
Message boards	Fast	Limited	Concentrated	Low
Aircraft	Slow	Limited	Concentrated	Low
Visual alerting	Fast	Limited	Concentrated	Low
Internet protocol (IP) based technology	Fast	Widespread	Dispersed	Very High to Medium
Social media	Fast	Widespread	Dispersed	Low

WEA DIFFUSION DATA

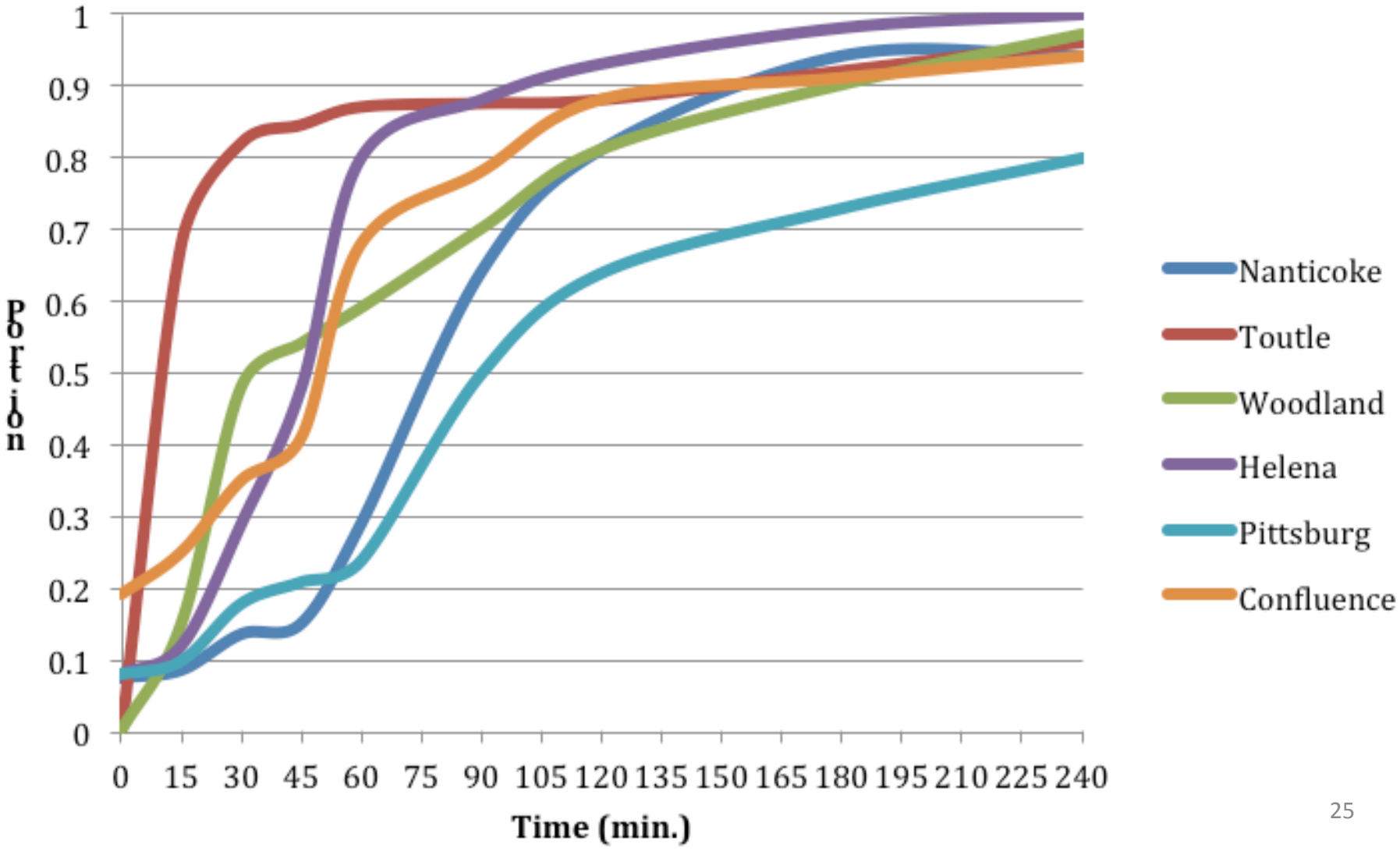


OROVILLE DIFFUSION RATES

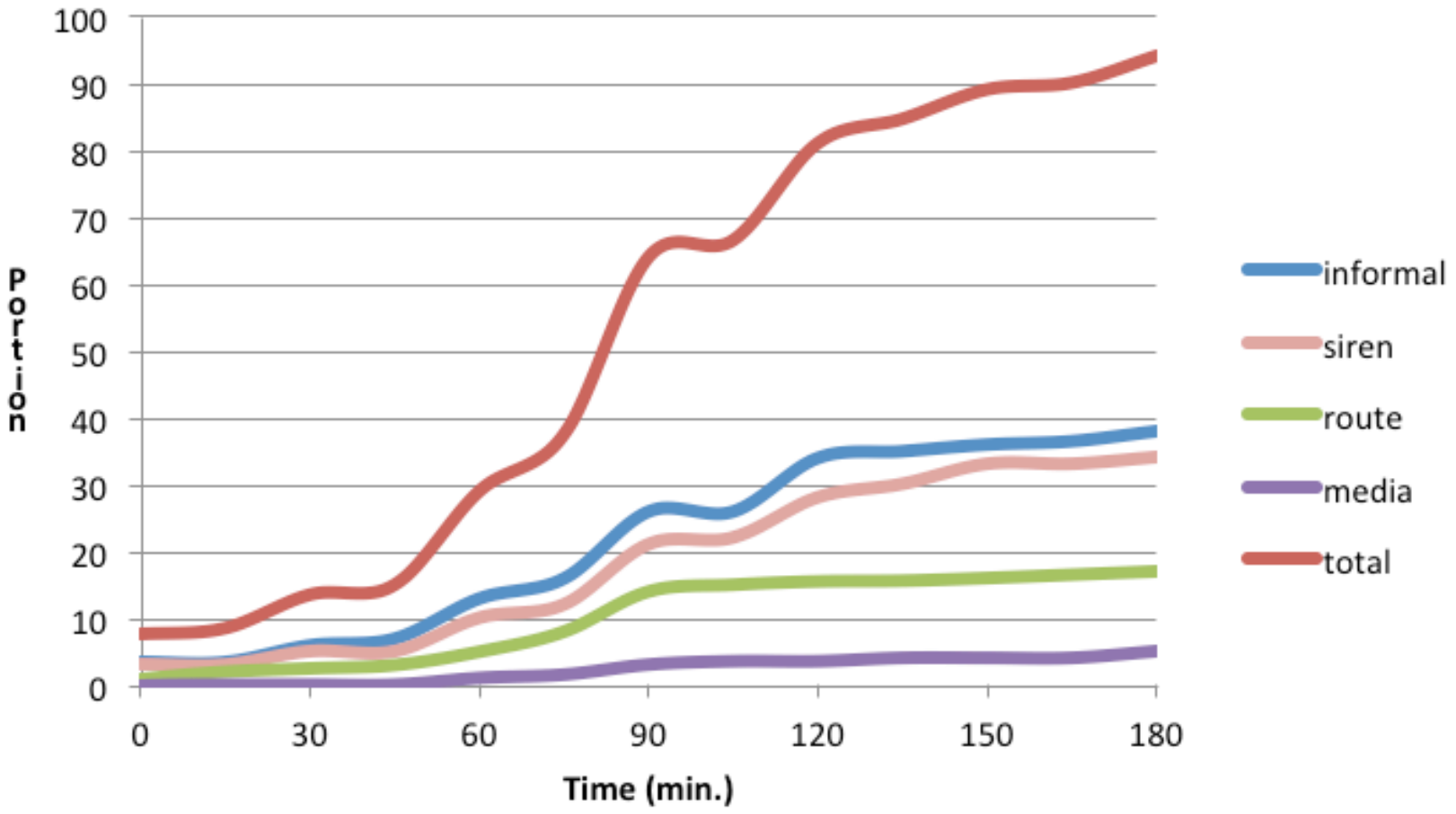
(February 2017)



HISTORICAL DIFFUSION DATA



VARIED DIFFUSION RATES



DIFFUSION DIVERSITY REDUCES DIFFUSION DELAY

- **Use *Multiple* Channels Diffusion**
  - **Yields quicker & more comprehensive audience penetration**
- **Comprised Of**
  - **Modern technologies, e.g., WEA, SMS**
  - **Old fashioned methods, e.g., TV, radio**
  - **Special ways for special sub-populations**
  - **Nest WEAs in a mix of other channels**

SOME NEED UNIQUE DIFFUSION CHANNELS

- **Hearing Impaired – text telephone (TDD/TTY)**
- **Visually Impaired – audio text translation**
- **Foreign Language – multiple language messages**
- **People In Transit – electronic message boards**
- **People On/Near Water – aircraft, sirens**
- **Institutionalized Groups – dedicated tone alert radios, automated telephone dialers**
- **Schools – dedicated tone alert radios, automated telephone dialers**
- **Field Workers – route notification**
- **Homeless – route notification**

REPETITIVE MESSAGING

- **Distribute Alert & Warning Messages Multiple Times**
  - **Reduces diffusion delay**
  - **Enhances audience penetration**

5. ISSUE MESSAGES THAT REDUCE PUBLIC ACTION DELAY

- **Myth**
  - **People immediately take protective actions when they receive a warning message**
- **Reality (Said Simply)**
  - ***While all the forest animals are running away from the flames, people who get a warning DELAY taking protective action and instead waste time searching the net, watching TV, & talking with neighbors trying to decide what, if anything, to do about the fire = MILLING***

MILLING

- **Human Nature Delays Protective Action (PAI) When Warned**
  - **Search for more information**
  - **Confirm warnings with others**
  - **Check out what others are doing**
  - **Personalize threat perceptions**
- **Other Reasons for PAI Delay Include**
  - **Reunification with intimates, pets, and protective action preparation**

MESSAGE OBJECTIVES

- **Minimize**
  - **Issuing alert & warning messages that motivate milling & increase delay**
- **Maximize**
  - **Issuing alert & warning messages that reduce milling delay that are *actionable* (motivate timely public action-taking)**

TWO CONSIDERATIONS

- **Use New 360 Characters-long WEA Alert & Warning Messages & Findings From New DHS WEA Research To**
  - **Craft public messages that reduce milling & reduce public action delay**
- **Share Knowledge About What Such Messages Would Look Like**
  - **With alert & warning originators**

FOR YOUR INFORMATION

SOME HISTORIC PAI DATA

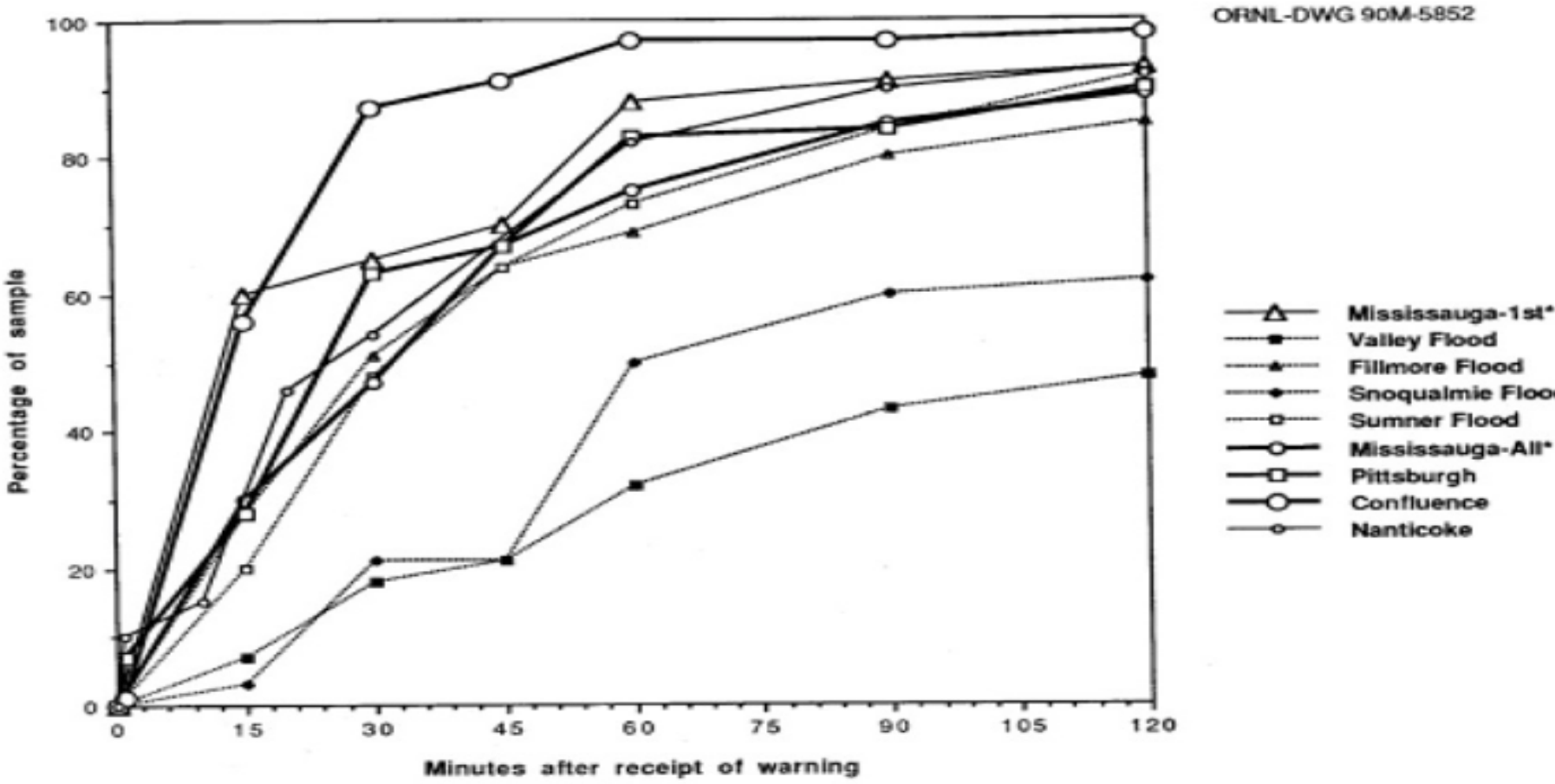
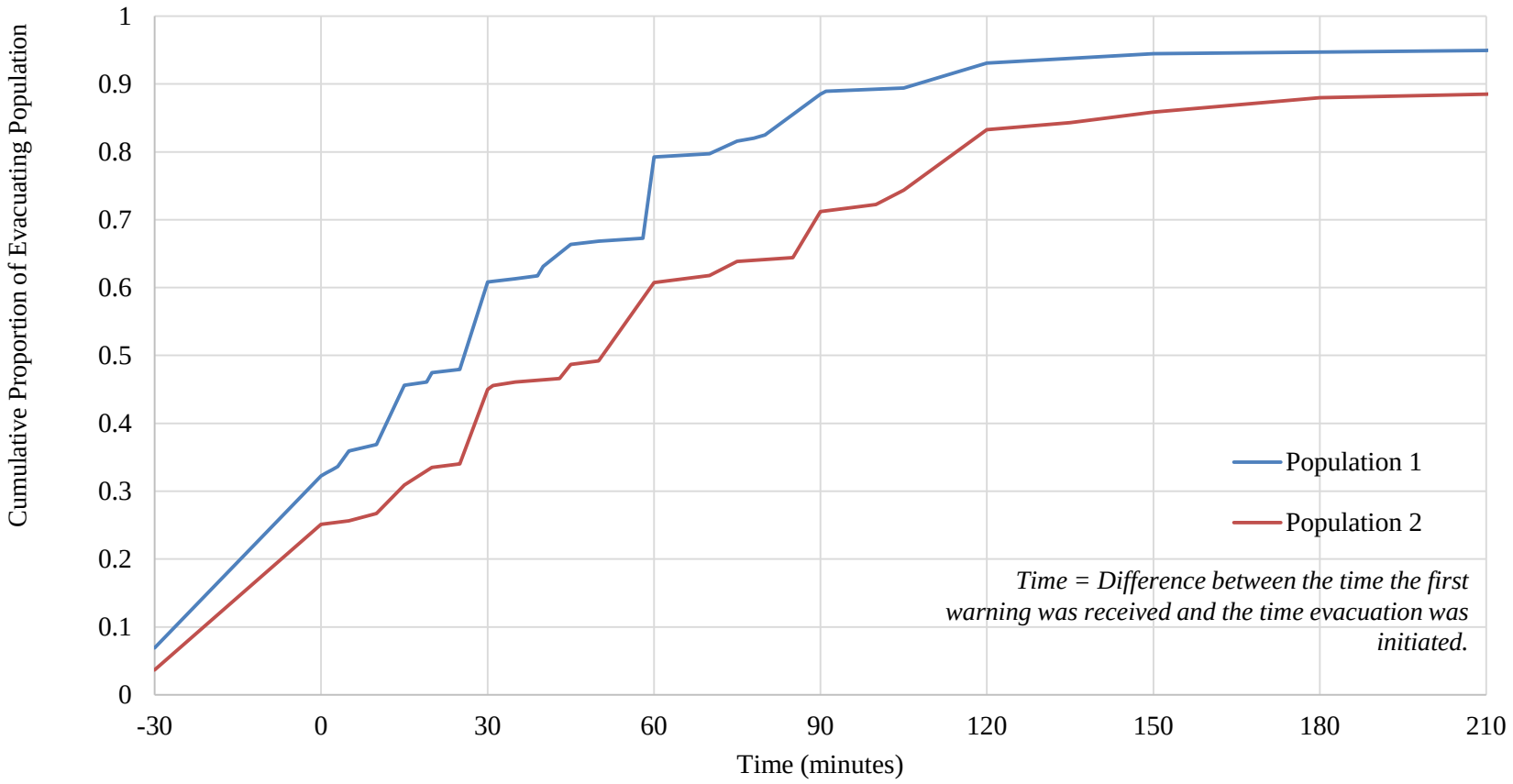


Fig. 5.2. Mobilization time in selected events. *First wave of evacuation for Mississauga accident designated (1st), all Mississauga evacuations designated (all).

OROVILLE PAI CURVES

(February 2017)



MESSAGE CORRELATES

VARIABLE	RANK	WEIGHT
Message Content	HIGH	.25 - .30
Message Style	HIGH	.17 - .22
Personal Channel	HIGH	.13 - .18
Delivery (Frequency)	HIGH	.12 - .15
Message Length Adequacy	MOD	.12 - .16
Protective Action Type	MOD	.05 - .10*

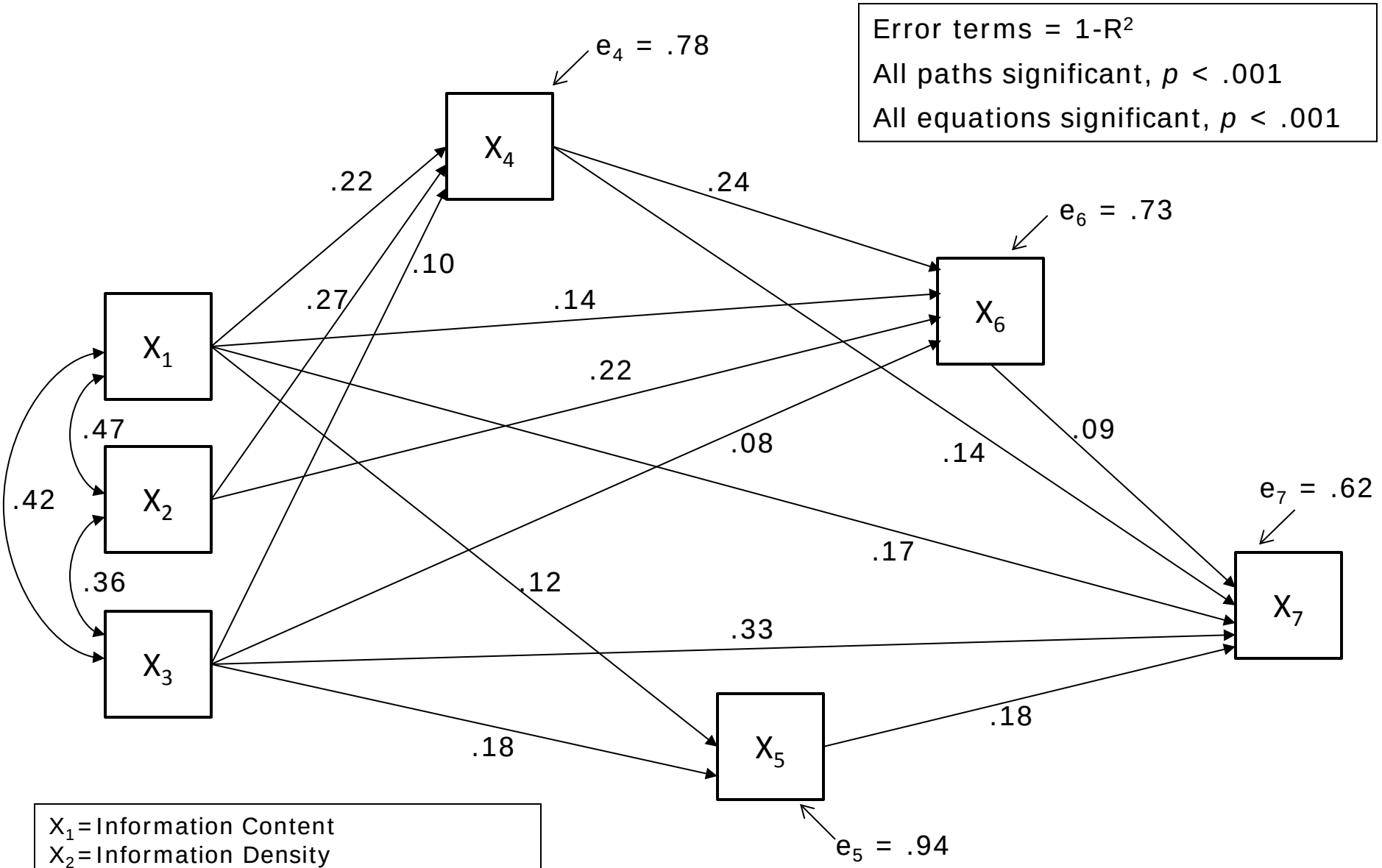
AUDIENCE CORRELATES

VARIABLE	RANK	WEIGHT
Role Characteristics	HIGH	.10 - .17
-Children, pets		
Status Attributes	MOD	.01 - .10
-Gender, age, SES		
Experience	MOD	.01 - .14
Member Isolated Group	MOD	.01 - .11
Personal Preparedness	LOW	.10 - .02
Pre Event Knowledge	LOW	.01 - .02

CONTEXT CORRELATES

VARIABLE	RANK	WEIGHT
Environmental Cues	HIGH	.05 - .28
Time To Impact	HIGH	.10 - .17
Impact Intensity	HIGH	.10 - .17
Social Cues	MOD	.05 - .13
Location/Activity	MOD	.05 - .15
Day Versus Night	LOW	.01 - .05

WHERE THE WEIGHTS CAME FROM


Error terms = 1-R²
All paths significant, p < .001
All equations significant, p < .001
e4 = .78
X4
.22
.24
e6 = .73
.10
.27
.14
X6
X1
.22
.47
.08
.14
.09
e7 = .62
.42
X2
.17
.36
.12
X7
.33
X3
.18
.18
X5
e5 = .94
X1=Information Content
X2=Information Density
X3=Information Observed (cues)
X4=Knowledge
X5=Perceived Effectiveness
X6=Information Seeking (milling)
X7=Preparedness Actions
Satora-Bentler χ² = 8.58, df = 4, p = .07
RMSEA = 0.020, 90% CI (.000 - .039)
CFI = 0.998

MESSAGE MATTERS MOST

- **The Warning Message**
  - **A. *Contents* (what it says)**
  - **B. *Style* (how it says it)**
- **Enhancements**
  - **Risk personalization visualizations**
  - **Message repetition**
  - **More (URLs?)**

MESSAGE STYLE

- **Be Specific**
  - **YES: If you are between the river and First Street, move north of Main Street**
  - **NO: Evacuate if you are near the river**
- **Be Clear**
  - **YES: A wall of water 20 feet high moving faster than a person can run**
  - **NO: A ten thousand cubic foot per second flow, moving at 20 feet per second**
- **Be Accessible**

MESSAGE CONTENTS

- **Objective**
  - **Put information in messages that people spend time looking for when its absent**
    - **Absent information incites milling & delays public protective action**
  - **Milling will *"never"* be completely eliminated but can be reduced**

MESSAGE ANATOMY

(comprehensive messages cover 8 topics)

- **1. Source**
- **2. Hazard**
- **3. Location Personalization**
- **4. Consequences**
- **5. Protective Action (PA)**
- **6. PA Completion Time**
- **7. How PA Reduces Consequences**
- **8. Message Expiration Time**

EXAMPLE MESSAGE

(339 Characters For New WEA 360 Message Length)

- *Elm County Sheriff Floodwaters are approaching Wood City and will hit two blocks on both sides of Elm Creek from Hwy 111 to Maple Road People outside will be washed downstream The water will be above rooftops Move 2 blocks+ from the creek NOW & be there no later than 6:00 PM to avoid the flood This message expires at 11:00 PM 15 May 2018*

ALERT & WARNING MODERNIZATION

GENERAL GOALS

- **Encourage Local Warning *Planning***
  - **Jurisdictional & multi-jurisdictional plans**
  - **Emergency planning works, not planning doesn't work quite as well**
- **Upgrade Alert Originator *Practices***
  - **Teach: educate them & give them courses**
  - **Provide guidance: give them a user's guide**
  - **Practice: give them training, drills & exercises**
- **Pathways Forward…….**

A. MODERNIZE PLANNING

- **Adoption Of Alert & Warning Plans**
  - **Develop & distribute simple alert & warning "*jurisdictional*" plan templates that provide guidance & best practices**
  - **Develop & distribute coordinated "*multi-jurisdictional*" alert plan templates that provide guidance & best practices**

B. MODERNIZE COMPLIANCE

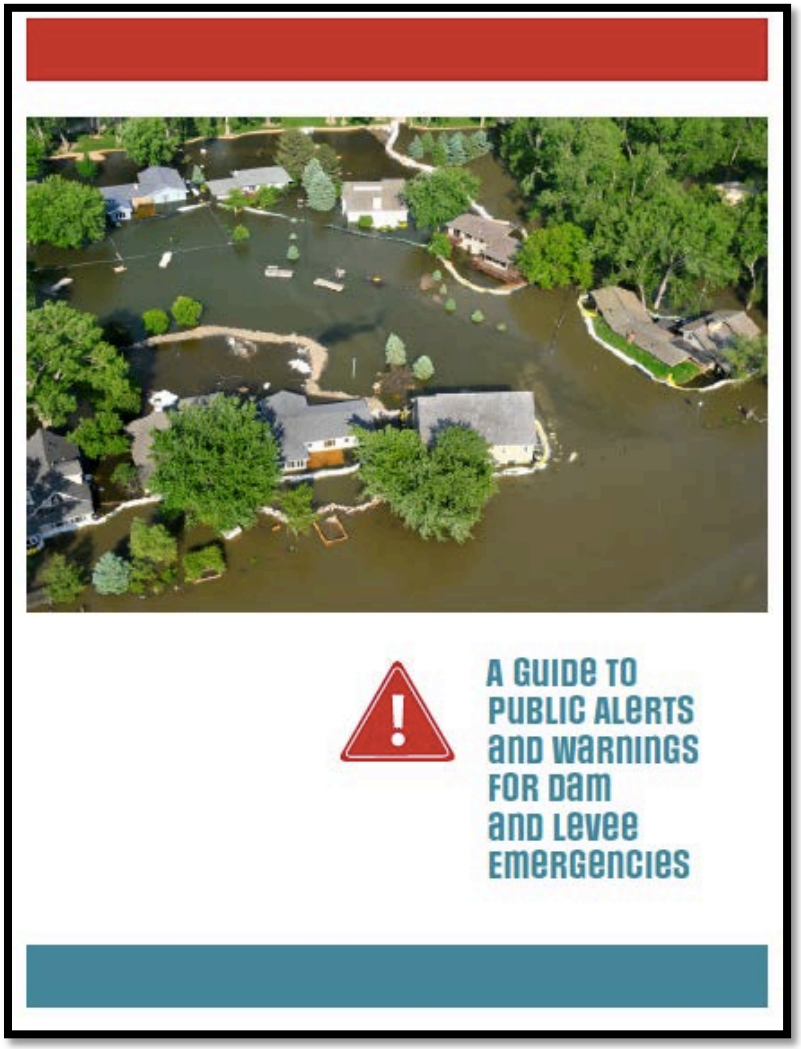
- **Message Education & Outreach**
  - **Develop & provide education, guidance, training, best practices, and templates for modern & accessible alert & warning messages particularly for rapid onset events to alert originators across the nation**
    - ***CONTENT*: source, hazard, location personalization, consequences, protective action (PA), PA time, how PA reduces consequences, & expiration time**
    - ***STYLE:* specific, clear & accessible**

C. MODERNIZE PENETRATION

- **Multiple Dissemination Channels**
  - **Integrate use of current and future alert dissemination tools to enable multiple-channel public alert dissemination**
    - **Use a mix of modern (WEA & SMS) and traditional ***formal*** dissemination channels (TV & radio) to accelerate audience penetration**
    - ***Informal*** **dissemination from relatives & friends (peer-to-peer) enhances penetration**

A RESOURCE DOCUMENT

ALERT/WARNING GUIDEBOOK



SEARCH FOR

"A Guide to Public Alerts and Warnings for Dam and Levee Emergencies"

(contents generalize across threat types)

A FEW THOUGHTS ABOUT TSUNAMIS

1 SIZE DOESN'T FIT ALL

- **Far Field Tsunamis**
  - **DAYS to impact: people will figure it out**
- **Intermediate Field Tsunamis**
  - **HOURS to impact: prior comments apply**
- **Near Field Tsunamis**
  - **MINUTES to impact: about pre-event public education, not alert messages**
- **A Few Comments On Public Education….**

PUBLIC EDUCATION

- **An Informed Program Based On**
  - **Risk communication science vs. intuition**
- **That Is Adequately Funded &**
- **Comprehensive**
  - **1. Audiences: residents (enculturation) & visitors**
  - **2. Content that is actionable**
  - **3. Diffusion mechanisms that maximize penetration**
  - **4. Visual aids in local communities**
- **Based On Cooperating**
  - **Government, tribal & NGO partners with champions**

THANK YOU

QUESTIONS?

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