

Risk Management and Safety Protocols in Trail Running Events

A Systematic Review from a Sports Management Perspective

* Corresponding author — farhatmahmudi@upi.edu

5th ISPESH 2026 — Paper Presentation

Farhat Mahmudi, Irgi Iksan Mulyana

Universitas Pendidikan Indonesia

International Seminar on Physical Education, Health and Recreation

ISPESH

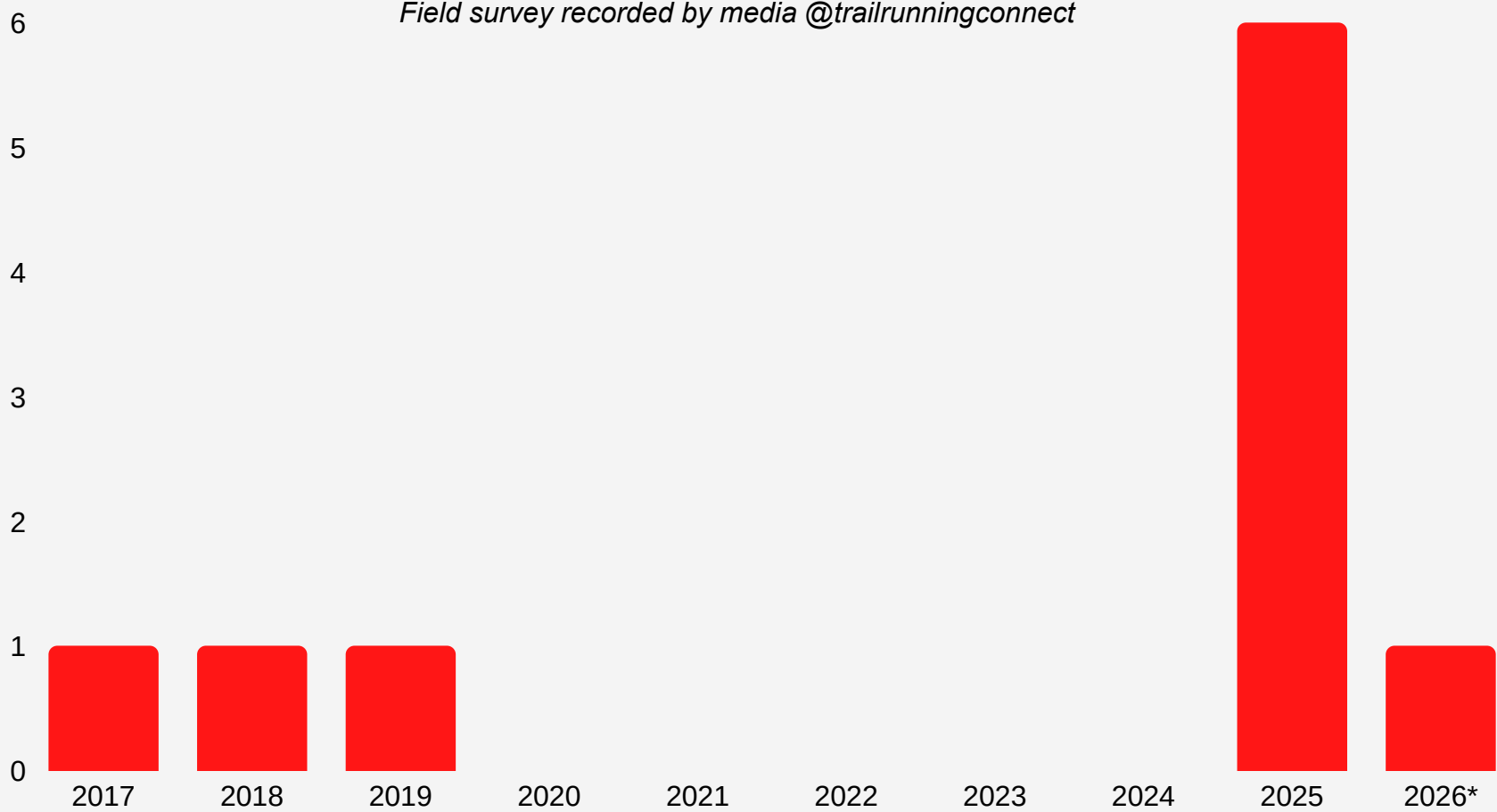
INTRODUCTION

The Post-Pandemic Rise of Trail Running — and Its Safety Cost

- Rapid growth post-COVID-19: ±1.77 million registered trail runners, 20 million participants/year, growing 12%/year across >10,000 global events (ITRA, 2025).
- Trail running ≠ road running: run outdoors, asphalt surfaces ≤20% of the route, non-standard terrain (rocks, slippery slopes, extreme inclines).
- Risks are multidimensional and interact: environmental, physiological, technical, and psychological.
- Indonesian fatality data shows a worrying pattern — a sharp spike in 2025 after five years of zero cases.
- The growth in participation has not been matched by improvements in risk management systems and adequate safety protocols.

(Fatal Incidents in Indonesian Trail Running, 2017–2026)

Field survey recorded by media @trailrunningconnect



Environmental

Extreme weather,
limited medical
access

Physiological

Hypothermia,
dehydration, collapse

Technical

Injury, fall, get lost

Psychological

Mental fatigue, wrong
decisions

INTRODUCTION

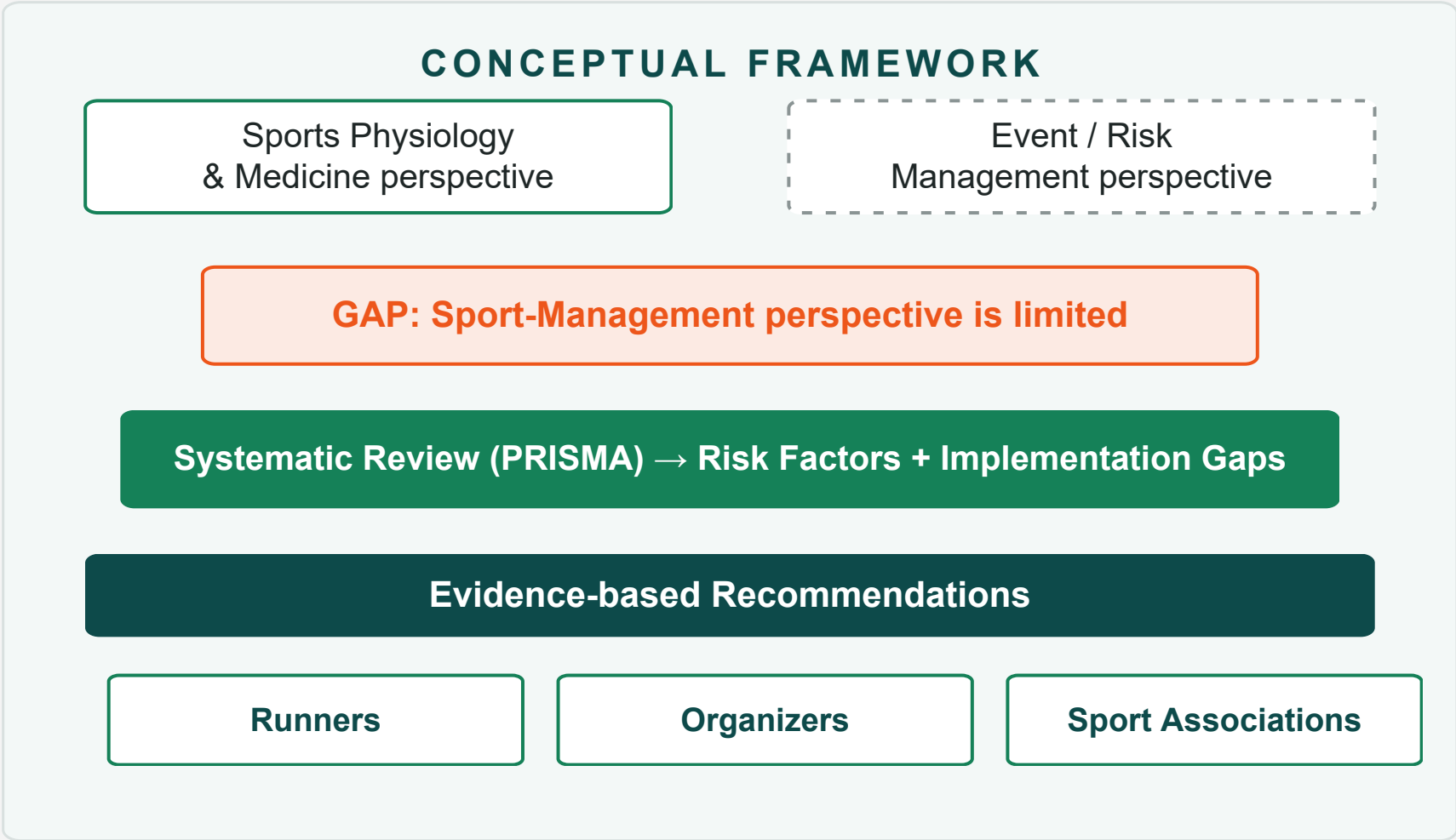
Research Gap, Objectives & Research Questions

RESEARCH GAP

- The majority of trail-running safety literature focuses on physiology and sports medicine.
- Studies from a sports management perspective are still very limited (Chappelet & Parent, 2015).
- There are few syntheses of best-practice safety protocols across countries.
- Indonesian national standards are still developing and have not been integrated into sports policy.

RESEARCH OBJECTIVE

Conducting a systematic review of international literature on risk management and safety protocols for trail running/ultra trail marathons from a Sport Management perspective.



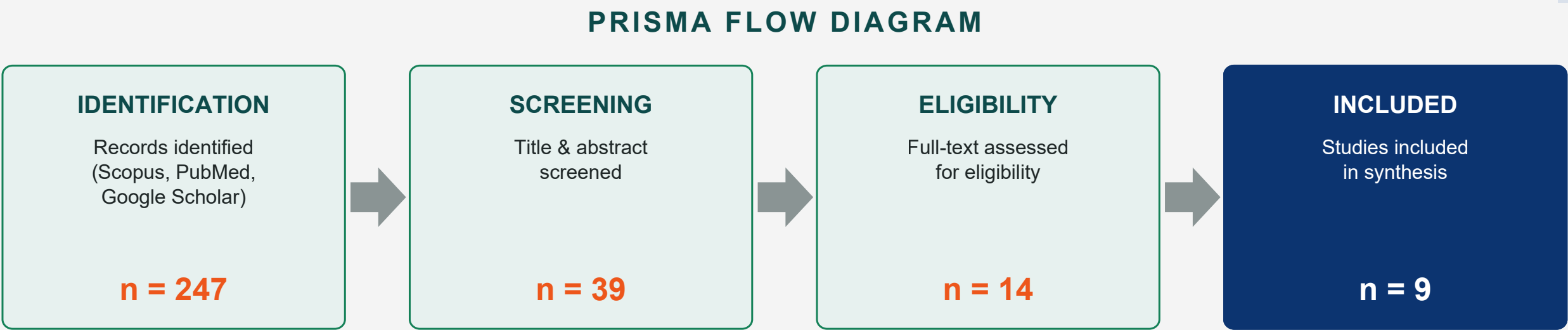
RESEARCH QUESTIONS

- RQ1 — What are the main risk factors (environmental, physiological, technical, organizational)?
- RQ2 — What are the gaps in the implementation of current safety protocols?
- RQ3 — What are the evidence-based recommendations for runners, organizers, and associations?

METHODS

Systematic Literature Review — PRISMA Protocol

- Design: Systematic Literature Review following PRISMA + Thematic Synthesis guidelines.
- Databases: Scopus, PubMed, Google Scholar.
- Selection: 247 articles identified, 9 of which met all criteria.
- Inclusion: 2020–2026, peer-reviewed, English language, relevant risk/safety.
- Analysis: Thematic Synthesis for cross-study patterns.



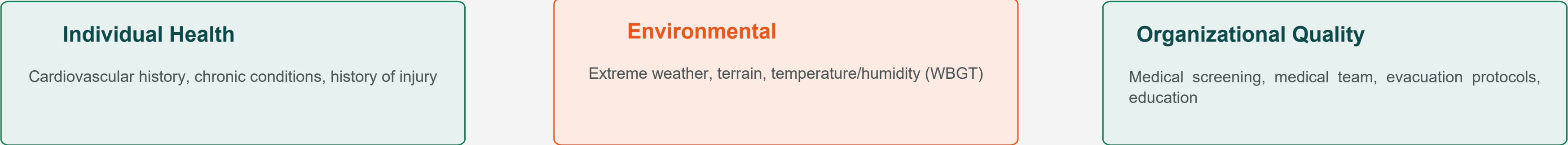
#	Author (Year)	Method	Key Finding
1	Yamaguchi & Ito (2021)	Qualitative (Thematic Analysis)	10 categories of risk perceived by runners; participant and environmental risks are interrelated
2	King (2020)	Retrospective descriptive	51 fatal incidents (12 years, Western Europe); main causes: cardiovascular, falls, hypothermia
3	de Boam et al. (2025)	Pilot observational (200 races, 67 negara)	Only 33% required a doctor's medical evaluation; 5–6% required nutrition education, 13% required hydration; 98% required waiver
4	C. Viljoen et al. (2025)	Systematic search — online news	127 cases; mortality 82%; causes: cardiovascular 58%, collapse 38%, hypothermia 40%
5	Lecina et al. (2022)	Systematic review (PRISMA)	Incidence of AKI 42.04%; EAH 9.44%
6	Vincent et al. (2022)	Systematic review + survei	Musculoskeletal injuries >70% due to overuse & poor neuromotor control
7	Soppelsa et al. (2025)	Quantitative (questionnaire)	Training volume, sleep, active rest days have a protective effect against injury.
8	C. T. Viljoen et al. (2021)	Prospective cohort	History of injury & chronic conditions doubled the risk of injury (OR 2.09 & 2.04)
9	Monpierre et al. (2025)	Observational case studies	2 cases of exertional heat stroke; core body temperature reached 41.7°C; rapid cooling required

RESULTS & DISCUSSION (1/2)

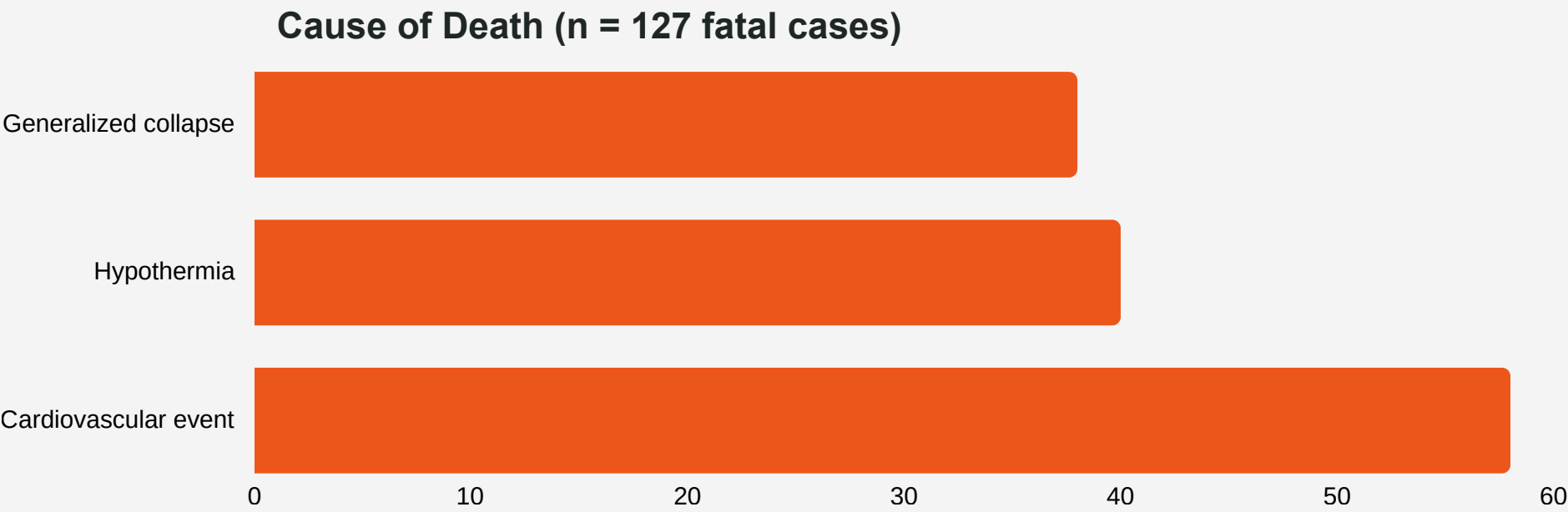
Risk as a Multidimensional Phenomenon

- Risk arises from the interaction of three pillars: Individual Health, Environmental Health, and Organizational Quality.
- Causes of Death: Cardiovascular 58% • Hypothermia 40% • Generalized Collapse 38% (categories may overlap).
- Victims: Average age 41.5–50 years, predominantly male.
- Injury incidence varies widely: 1.6–187.9 per 1,000 hours of running.
- MMR 42.04% & EAH 9.44% — in contrast to the low levels of nutrition education (5–6%) & hydration (13%).

INCLUDED



Fatal risks and serious injuries = the result of the interaction of the three pillars (not the fault of one party)

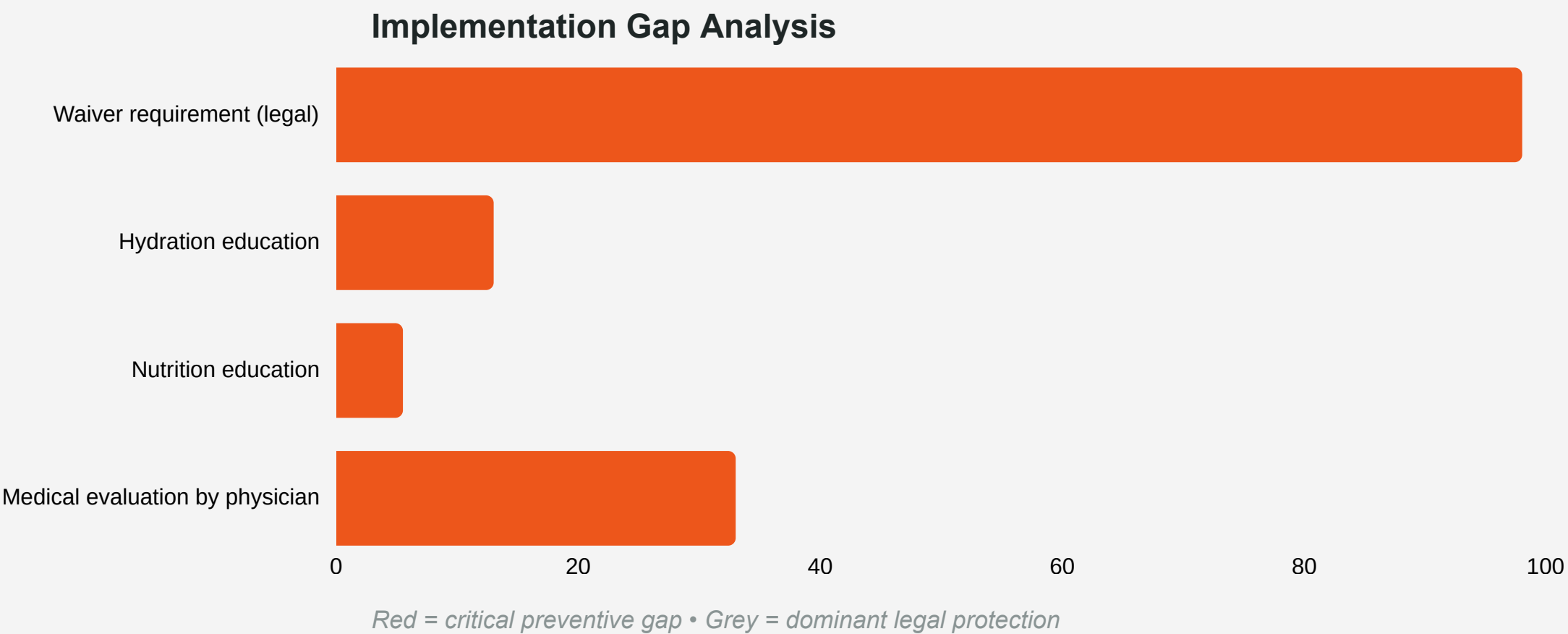


Indicator	Value
Serious adverse event mortality	82% (n=127)
Average age of fatal victims	41,5–50 th
Injury incidence (range)	1,6–187,9/1.000 jam
Incidence of AKI	42,04%
Incidence of EAH	9,44%

RESULTS & DISCUSSION (2/2)

Implementation Gaps & the 3-Stakeholder Framework

- The largest gap is in medical screening: only 33% of organizers require a doctor's evaluation.
- Participant education is minimal: nutrition 5–6%, hydration 13%—in contrast to MMR 42% and EAH 9.4%.
- 98% of events require waivers—a legalistic approach dominates, not a preventative one.
- The gap is systemic, not the fault of any single party.
- The recommendation framework covers four categories: Medical, Equipment/Infra, Education, Data & Research.



RUNNERS

- Cardiovascular screening 3–6 months before the race
- Basic CPR certification
- Structured mountain terrain training
- Bring emergency supplies (GPS, warm clothing)

ORGANIZERS

- APSS-based medical screening
- Trained medical team + emergency equipment
- Evacuation & weather monitoring system
- Clear lane marking (≤100m)

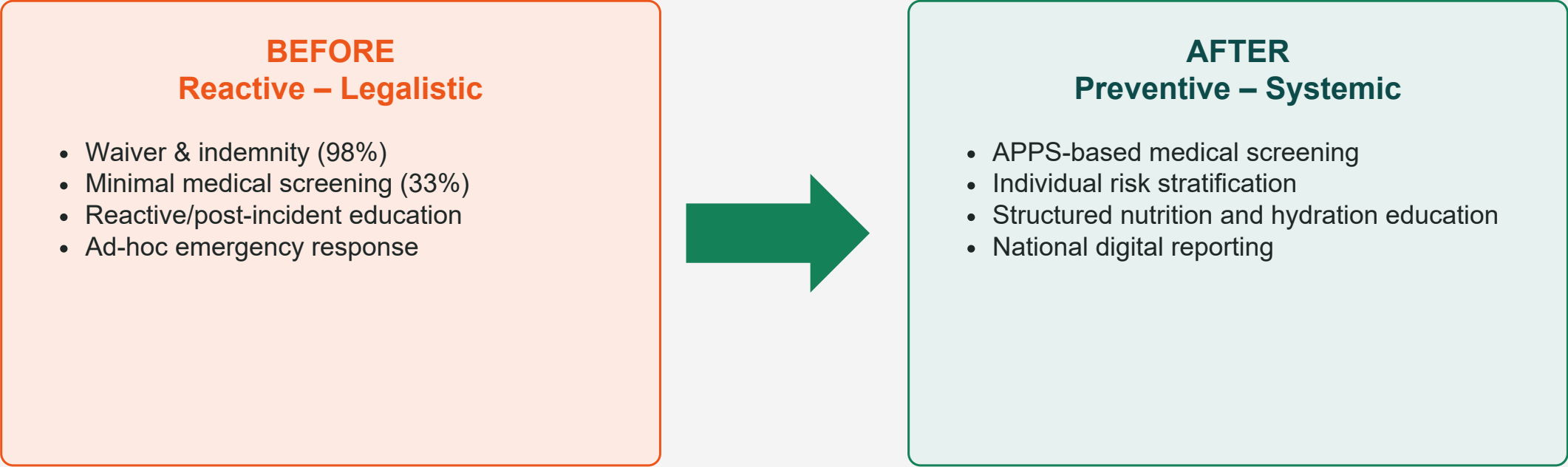
ASSOCIATIONS

- National risk management standards
- Mandatory certification of providers and medical teams
- National digital reporting system
- Multicenter research facilities

From Reactive-Legalistic to Preventive, Systemic & Evidence-Based

- The risks of trail running are multidimensional: they interact with individual health, the environment, and the quality of the event.
- Cardiovascular disease remains the leading cause of death (58%); musculoskeletal injuries dominate non-fatal incidents.
- High experience ≠ low risk — runners with more than 6 years of experience are actually more susceptible to injury.
- Indonesian data (a surge of 6 deaths in 2025) reinforces the urgency of these findings.
- A paradigm shift toward a preventative, systemic, and evidence-based model is needed.

PARADIGM SHIFT



FUTURE RESEARCH RECOMMENDATIONS

- ✓ Multicenter intervention trial to test the effectiveness of the protocol
- ✓ Validated risk stratification instruments (tropical and mountainous)
- ✓ National digital reporting system (fatal, injury, near-miss)
- ✓ Integration of sport science and sport management (theoretical contribution)
- ✓ Evidence-based reference for policy (practical contribution)

REFERENCES & ACKNOWLEDGMENT

KEY REFERENCES (APA 7th)

- Chappelet, J.-L., & Parent, M. M. (2015). Routledge handbook of sports event management. Routledge. <https://doi.org/10.4324/9780203798386>
- de Boam, P., Williams, E., Geytenbeek, M., & Peoples, G. (2025). Pre-race medical screening and harm reduction approaches in ultra-endurance racing. JSAMS Plus, 6, 100113.
- King, D. (2020). Fatal events related to running competitions in the mountains. Wilderness & Environmental Medicine, 32(2), 176–180.
- Lecina, M., Castellar-Otin, C., Lopez-Laval, I., Carrasco Paez, L., & Pradas, F. (2022). Acute kidney injury and hyponatremia in ultra-trail racing: A systematic review. Medicina, 58(5), 569.
- Leopkey, B., & Parent, M. M. (2009). Risk management issues in large-scale sporting events. European Sport Management Quarterly, 9(2), 187–208.
- Viljoen, C., et al. (2025). Trail running safety: a review of serious adverse events reported in online news articles. Wilderness & Environmental Medicine, 36(3), 416–433.

A complete bibliography (±90 references) is available in the full text / upon request.

ACKNOWLEDGMENT

The authors would like to thank colleagues and institutions of the Indonesian University of Education for institutional support in completing this research.

CONTACT

Farhat Mahmudi (Corresponding Author)

farhatmahmudi@upi.edu

Universitas Pendidikan Indonesia

Thank You

*Together towards safer
trail running.*

5th ISPESH 2026