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An Investigation of a Tour Bus's Side Collision with Roadside Trees on National Highway No. 41, Pa We Subdistrict, Chaiya District, Surat Thani Province, Thailand, 3–4 Jan 2025

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Abstract

On 1 Jan 2025, at 7:25 PM, a tour bus driver lost control of his vehicle after overtaking a truck and had a side collision with roadside trees on National Highway No. 41 in Surat Thani Province, Thailand. The investigation was conducted to detail the accident's chronology and describe the epidemiology of the injuries and fatalities. Factors associated with the cause(s) of the accident, injuries, and deaths were identified. Road traffic injury countermeasures were consequently proposed. We reviewed medical records, post-mortem inquest reports, closed-circuit television footage and interviewed witnesses. We surveyed the collision site and interviewed rescuers, medical officers, and survivors, utilizing Haddon's matrix for the analysis of contributing factors from various perspectives. The tour bus, carrying 35 passengers and two drivers, was traveling on a round-trip journey from Nakhon Pathom Province to Pattani Province. During the return leg, the driver attempted to overtake a truck, and moved from the left lane to the right lane on a two-lane highway. The bus driver lost control of the bus and collided with roadside trees in the depressed median. All were injured and five (13.5%) were dead at the scene. There were 23 females and 14 males, with a median age of 60 years (range 9 to 75 years). The main causes of the accident were the driver's unfamiliarity with the route, a lack of lane markings and shoulder delineations, and poor visibility due to limited road lighting. We recommended that the road safety environment be improved, especially for roads under construction.

Keywords: tour bus, accident, investigation, roadside trees

Introduction

Approximately 1.19 million lives are lost from road traffic accidents annually, and between 20 and 50 million have suffered from various forms of disability.[1] In response to this global crisis, the World Health Organization, as a secretariat for the United Nations Decade of Action for Road Safety 2021–2030, has committed to reducing road traffic deaths and injuries by at least 50% in 2030.[1] In 2021, Thailand had a road traffic death rate of 25.4 per 100,000 population, which was one of the highest in Asia and upper-middle-income countries. In addition, Thailand was ranked ninth out of 175 World Health Organization member states for road traffic deaths.[2] This resulted in economic loss from fatalities and severe injuries, estimated at 531,058 million Thai baht in 2022, equivalent to 3.1% of the nation's gross domestic product.[3] Tour buses do not rank among the top ten vehicle types with the highest accident rates; however,

road traffic accidents involving tour buses often result in serious consequences with a significant number of injuries and deaths in a single event, and these accidents could have a profound negative impact on tourism, undermining public confidence and discouraging travel.

On 1 Jan 2025, the joint investigation team was notified of a tour bus that had lost control and crashed into roadside trees on National Highway No. 41 in Surat Thani Province, Thailand. The incident resulted in five deaths at the scene and 25 injuries. The joint investigation team from the Office of Disease Prevention and Control 11 Nakhon Si Thammarat, Surat Thani Provincial Public Health Office, Surat Thani Disaster Prevention and Mitigation Office, and Chaiya Hospital, investigated this event from 3–4 Jan 2025. The objectives of this investigation were to: 1) detail the event's chronology, 2) describe the epidemiological characteristics of injuries and deaths, 3) examine factors that contributed to the accident and the severity of injuries and fatalities, and 4) propose preventive measures for future road traffic accidents.

Methods

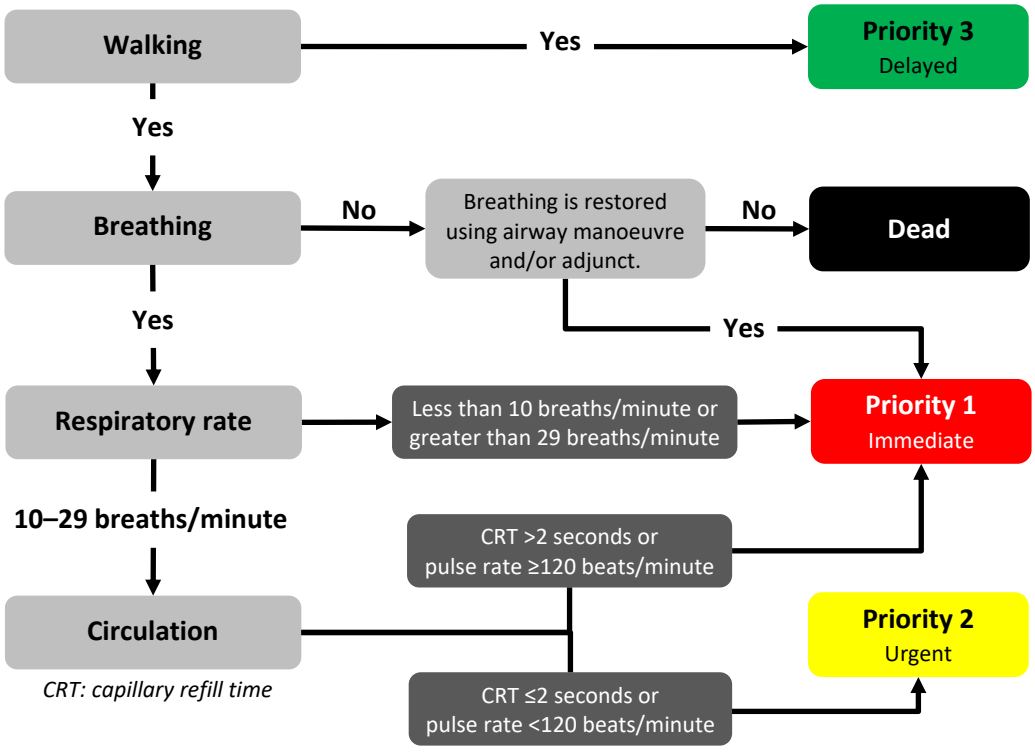
This descriptive study was conducted by utilizing the road traffic injury and fatality investigation form to assemble data from various approaches corresponding to the aims of the investigation, as follows:[4]

Reconstructing the Incident's Chronology

All individuals related to this event were interviewed, including drivers, survivors, rescuers, healthcare workers at Chaiya Hospital and Tha Chang Hospital, and eyewitnesses at the scene. Closed-circuit television footage of pre-crash, crash, and post-crash events was observed.

Descriptive Epidemiology of Injuries and Deaths

The medical records and post-mortem inquest report of two hospitals, Chaiya Hospital and Tha Chang Hospital, were reviewed. An accident victim was an individual involved in the tour bus accident on National Highway No. 41, Pa We Subdistrict, Chaiya District, Surat Thani Province, on 1 Jan 2025. Cases included those with any level of physical injuries and were categorized into four categories according to injury severities by triage sieve protocols, as shown in Figure 1.[5]



Severity	Definition
Dead	Dead at the scene, dying, or euthanatized
Immediate	Requires immediate resuscitation to avoid death
Urgent	Requires surgery or treatment within 4 hours
Delayed	Ambulatory and can wait longer than 4 hours without treatment

Figure 1. Triage sieve algorithm and explanation of severity

Determinants Resulting in Incidence Occurrence and Factors Influencing Injuries and Fatalities

Haddon's Matrix was applied to define factors contributing to the accident and those that led to injuries and fatalities.[6] This approach was used to analyze the risk components of injuries in the aspects of human, vehicle, road, and environment during the pre-crash, crash, and post-crash periods as follows:

A) Human factors

Factors related to humans, including 1) the driver involved at the time of the incident was interviewed to assess driving behavior and experience, underlying medical conditions, and route familiarity. Other medical information was gathered from medical examinations, such as blood alcohol levels and urine tests for methamphetamine use, and 2) passengers were evaluated for their risk factors, such as seatbelt use and seat maps.

B) Vehicular factors

Factors associated with the vehicle were examined through interviews with the investigating police officer. The investigation included an assessment of the bus's condition from the wreckage and statements from police, especially concerning the conditions of the tires, and the availability of seatbelts, airbags, brake system, and other onboard equipment. The post-crash status of the speedometer was inspected. Reports from the Provincial Land Transport Office of Surat Thani were reviewed to obtain the vehicle's appearance, tax and inspection expiration date, tire production year, and driver's driving license. Data were collected on the bus's speed and location from the global positioning system (GPS).

C) Environmental factors and related systems

Road, environmental, social, and related system factors were examined. Data on the road and environment, including road type, number of lanes, and roadside objects, were collected. Tire marks between the bus and the trees were measured by the police. Social and related systems data were gathered through interviews with emergency response teams at the scene and medical staff from Chaiya Hospital and Tha Chang Hospital to define the time frame from activation time to arrival at the hospital.

Ethics

This study was a part of the routine investigation and response activities of the Department of Disease Control, Ministry of Public Health, Thailand. Therefore, ethical approval was not required.

Results

Incident's Chronology

The tour bus was operated by two male drivers unfamiliar with the route and carried 35 passengers from Nakhon Pathom Province to Pattani Province on 28 Dec 2024. On the return leg on 1 Jan 2025, the bus departed Hat Yai District at 9:00 AM, arriving at Wat Phra Mahathat Woramahawihan in Mueang District, Nakhon Si Thammarat Province at 1:00 PM. By 3:00 PM, the bus reached Wat Chedi Ai Khai in Sichon District. The bus then proceeded to Surat Thani Province, arriving at a bus inspection station in Tha Chang District at 6:54 PM. Highway police assessed the vehicle's condition, engaged with the drivers, and instructed passengers to fasten their seatbelts.

The bus continued along a road that was under construction before the Chaiya Intersection, where southbound traffic was diverted to two northbound lanes for a two-way flow. Traffic congestion limited vehicle speeds. After this area, normal road flow resumed. GPS data showed that between 7:23 PM and 7:25 PM, the bus accelerated from 34 kilometers per hour (km/h) to 62 km/h and subsequently reached 81 km/h. At 7:25 PM, the vehicle, traveling in the left-hand lane behind a six-wheeled truck, attempted to overtake the truck on the right.

While the bus was overtaking the truck, the right front wheel of the bus moved onto the road's shoulder, which was 1–2 feet wide and covered with loose soil and grass. The driver, aware of the impending danger, accelerated the vehicle. An expert from the forensic police supported this supposition due to the existence of grass on the surface of the soil approximately 2–3 meters before the spot where the bus descended into the depressed median. After this distance, there was evidence of crushed grass made by tire marks of a vehicle travelling at high speed, suggesting that the speed of the bus during the collision was higher than 81 km/h. After the bus descended into the depressed median, which was sloped at an angle of approximately 40 degrees, it collided with three large trees (Figure 2).

The road was constructed of concrete and had been in use since June 2024. In this particular section of the road, there was a lack of lane markings, shoulder delineations, and street lighting. The incident occurred at night, during low visibility.

Nearby residents notified emergency services via the 1669 hotline, with the Narenthorn Center in Surat Thani Province receiving the report at 7:29 PM.

Response teams were immediately dispatched, with a foundation rescue vehicle arriving at the scene by 7:33 PM and an advanced life support (ALS) ambulance from Chaiya Hospital arriving at 7:53 PM.

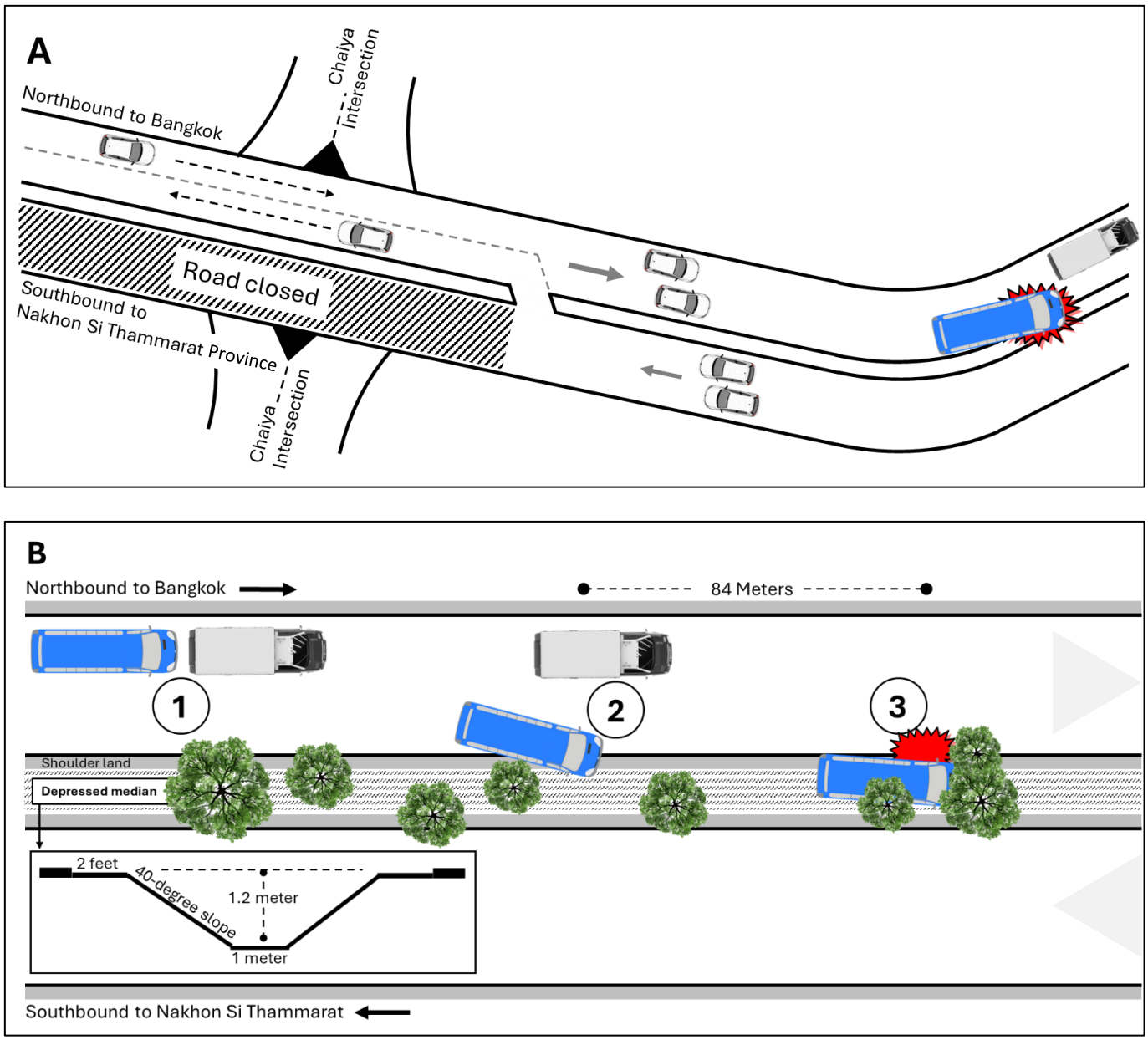


Figure 2. A diagram of National Highway No. 41 with a 2-kilometer stretch of road before the accident site (A) and pictorial of events (B) of a tour bus before (1) and during (2) overtaking a truck, and after colliding with trees (3), Surat Thani Province, 1 Jan 2025

Descriptive Epidemiology of Injuries and Fatalities

The incident involved 37 individuals. All were injured and five (13.5%) were dead at the scene. There were 23 females and 14 males with a median age of 60 years (range 9 to 75 years). Among the 32 injured survivors, 22 (68.8%) were triaged as delayed, 8 (25.0%) as urgent, and 2 (6.2%) as immediate at the scene. Twenty-five injured individuals were hospitalized, while seven declined medical treatment for personal reasons.

Among the injured individuals or fatalities, multiple organ injuries were observed. The affected organs were classified through the injury severity score (ISS).[7] Out of the 25 individuals who were injured and hospitalized, 17 (68.0%) had extremity injuries, followed by 11 (44.0%) with injuries to the thoracic region and 7 (28.0%) with injuries to the head and neck (Figure 3A). Of the five who died at the scene, all had injuries on their extremities, and three had injuries to the head and neck (Figure 3B).

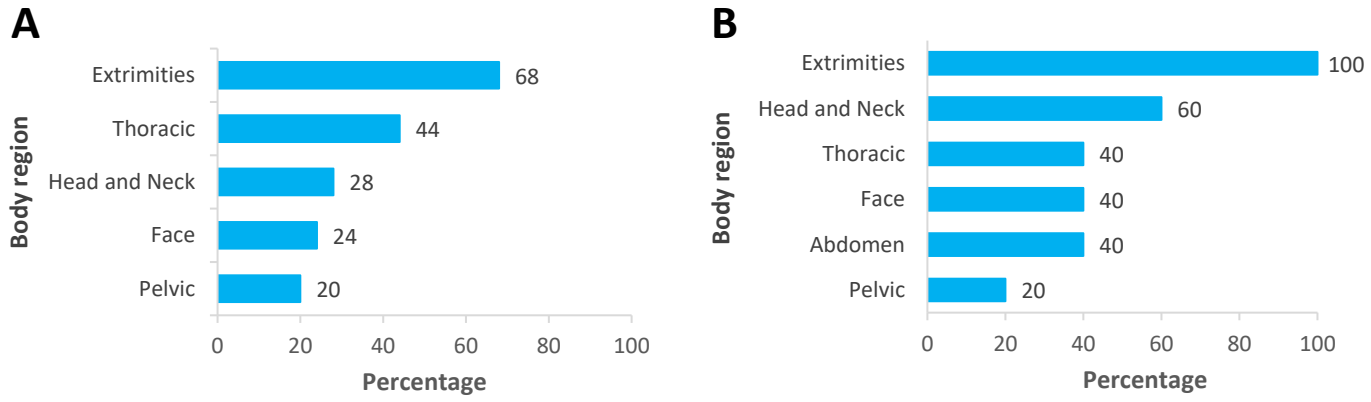


Figure 3. Characteristics of the body regions injured from an accident on National Highway No. 41, Surat Thani Province, 1 Jan 2025, distinguishing those injured, n=25 (A) and died, n=5 (B)

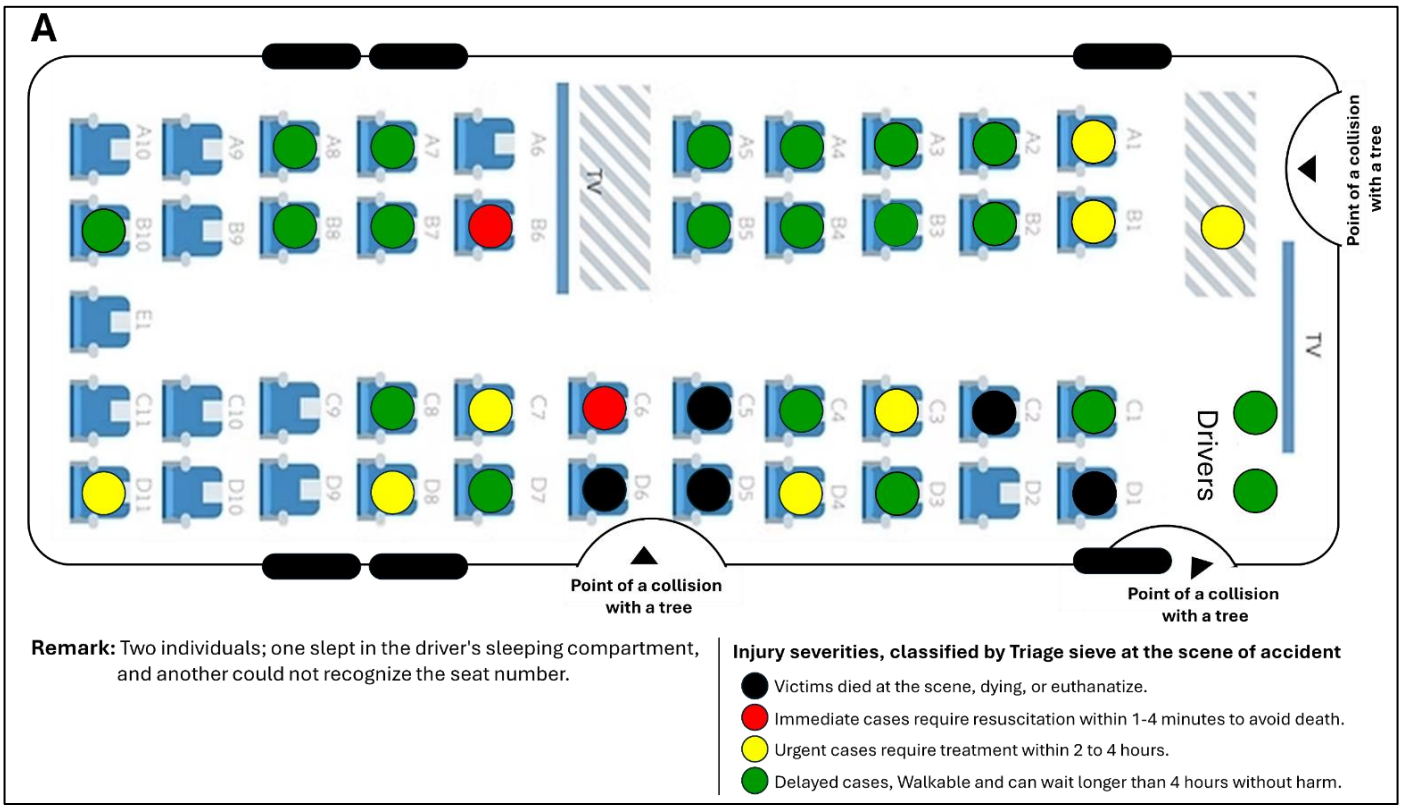
As shown in Table 1, livor mortis was a common finding in all deaths. The causes of death were massive intra-abdominal hemorrhage (n=2), cervical spine fracture with spinal cord injury (n=2), and severe head injury (n=1).

Table 1. Characteristics of the injuries among the five fatalities and causes that led to death

No	Gender	Age	Injury manifestation and post-mortem inquest results	Cause of death
1	Female	54	- Lacerations on the right temple (5.0 x 1.0 cm, extending to the skull) and above the right eyebrow (2.0 x 1.0 cm). - Abrasions on the right chest (5.0 x 0.5 cm) and the back of the right hand (2.0 x 1.0 cm). - Postmortem lividity showed as a purplish-red discoloration, blanching when pressed.	Severe head injury
2	Female	58	- Lacerations on the lower lip (4.0 cm), chin (5.0 x 1.0 cm), and right thigh (7.0 x 1.0 cm), with an open fracture of the left forearm, nearly amputated. - Postmortem lividity showed purplish-red discoloration, blanching when pressed. - A positive hepatorenal finding in the supraumbilical region suggesting blood accumulation.	Massive intra-abdominal hemorrhage
3	Female	58	- Laceration on the right elbow (10.0 x 2.0 cm). - Postmortem lividity on the back and hip showed purplish-red discoloration, blanching when pressed. - Both eyes were closed with non-resilient corneas, and rigor mortis was present in the jaw, neck, fingers, wrists, and knees.	Cervical spine fracture with spinal cord injury
4	Male	61	- Abrasion on the right thigh (10 cm). - Postmortem lividity on the back showed as purplish-red discoloration, blanching when pressed. - Rigor mortis was present in the jaw, and a positive spleen-renal finding, suggesting blood accumulation.	Massive intra-abdominal hemorrhage
5	Male	74	- A scratch wound on the right neck, with ecchymosis on the forehead. - Laceration on the right forehead (6.0 x 2.0 cm). - Postmortem lividity on the back showed purplish-red discoloration, blanching when pressed. - Rigor mortis was present in the jaw and neck.	Cervical spine fracture with spinal cord injury

cm: centimeters.

Figure 4A illustrates the distribution of accident victims based on the location of their seats. Those who died at the scene sat closest to the points of collision with the trees. Victims who were triaged as immediate and urgent sat adjacent to those who died. After the collision, the bus came to rest in the position shown in Figure 4B. None of the passengers had their seatbelts fastened. Consequently, passengers who sat on the left side of the bus were thrown to the right, resulting in more severe injuries for those seated on the right side.



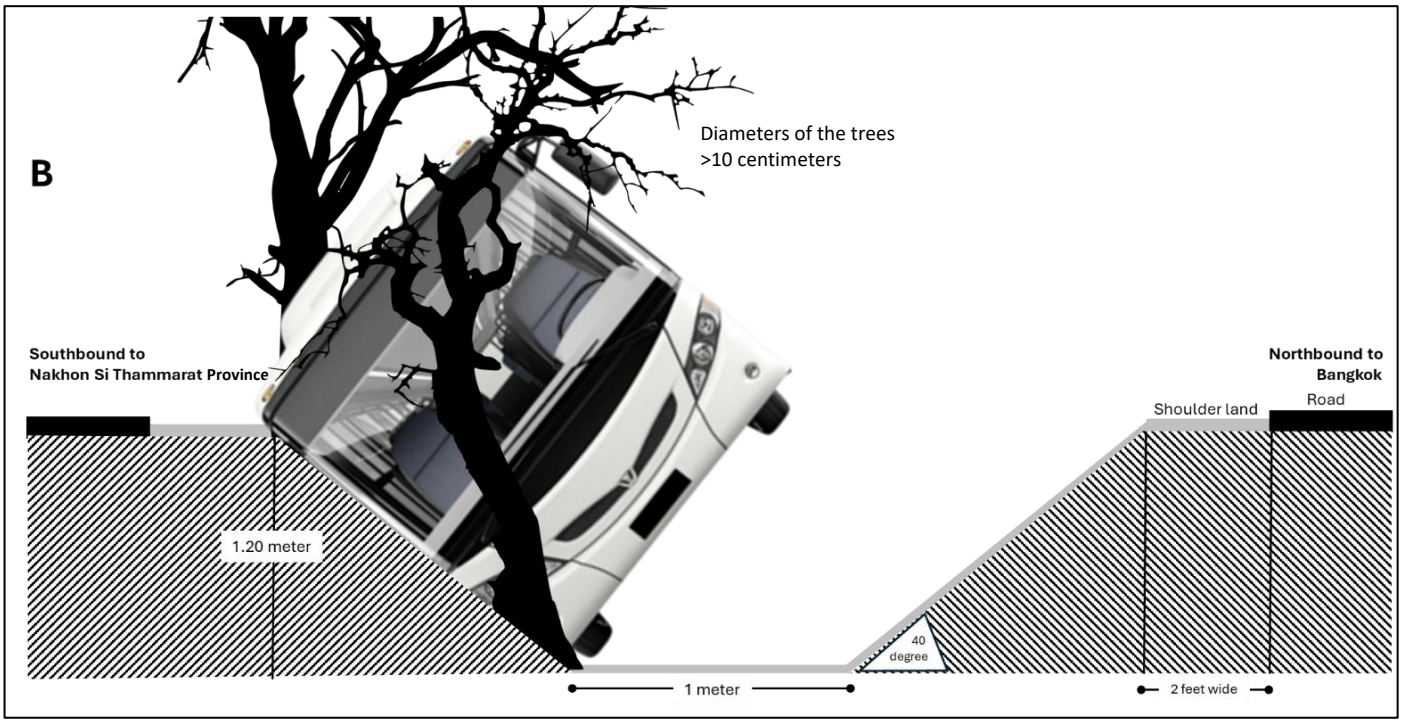


Figure 4. Bus seat map showing the distribution of injury severities (A) and the bus's final position during the post-crash period in the depressed median (B), National Highway No. 41, Surat Thani Province, 1 Jan 2025

Contributing Factors of the Accident

A) Human factors

A 46-year-old male driver, holding a vehicle driving license class 2, was involved in a crash. Blood alcohol and addictive substances were not detected. GPS data indicated that the driver drove at 81 km/h before impact and wore a seatbelt. The driver was from outside the area and may have been unfamiliar with the road as he had never operated along this specific route. None of the passengers wore seatbelts, causing them to be thrown from their seats and land on other passengers.

B) Vehicular factors

The tour bus was manufactured in 1997. It was operated by two other companies before it was bought in 2024 by the current company, which has a valid license for operation. The latest inspection was conducted on 25 Dec 2024, and the results showed sufficient function for operation. The brake system and condition of the tires were in the normal range. The tires were produced in the 16th week of 2022. No modifications to the bus were observed, and all seats had seatbelts available (Table 2). After the crash, some parts of the bus were crumpled, particularly at the collision sites.

Table 2. General information of the tour bus involved in the accident on National Highway No. 41, Surat Thani Province, 1 Jan 2025

Information	Details
Brand and model	Hino
Type of vehicle	Tour bus
Tax expiration date	1 Jul 2029
Latest inspection date	25 Dec 2024
Color	Mostly green, decorated with white, blue, and black
Transmission type	Manual
Engine size	Nissan 6-engine, 330 horsepower
Dimensions	14,000 kilograms weight Total weight: 16,200 kilograms
Maximum number of passengers	38
Safety and protective system	100% availability of seatbelt, good condition of brake system
Year of vehicle/tire production	1997/16th week of 2023
Any modifications	Unobservable

C) Environmental factors and related systems

The incident occurred on National Highway No. 41, at marker 129+700 km, coordinates N 9.408897, E 99.164044, in Pa We Subdistrict, Chaiya District, Surat Thani Province. The road is a straight asphaltic concrete surface designed for mono-directional traffic. The northbound road to Bangkok was constructed to standard specifications and consists of two 3.50-meter lanes with 1.50-meter shoulders. It is separated from the southbound road to Nakhon Si Thammarat Province by a depressed median, as illustrated in Figure 4B. Although the highway has been operating since June 2024, compulsory components, including lane markings, shoulder delineations, and street lighting, were not presented. The accident occurred at night and at the end of a curve in the road. Many large roadside trees were present along the roadway with diameters exceeding 10 centimeters.

Residents reported the accident to Hotline 1669 at around 7:29 PM. Response teams were dispatched, and a foundation rescue vehicle arrived at 7:33 PM to perform vehicle extrication. Chaiya Hospital was notified at 7:43 PM, and ALS ambulances were dispatched at 7:44 PM, arriving at 7:53 PM.

Initial confusion regarding who was coordinating the situation, as there was no commander present at the scene, led to a delay in the evaluation of the accident and the number of victims. However, the arrival of the ALS ambulance team facilitated the resolution of these issues. Five black-tagged cases were referred by foundation rescue teams to Chaiya Hospital, while the ALS ambulance delivered the remaining injured individuals to Chaiya Hospital or Tha Chang Hospital. All cases were completely referred by 9:10 PM, and the last case arrived at the nearest hospital by 9:25 PM.

The application of Haddon's matrix to the tour bus accident is shown in Table 3, which presents contributing factors of the accident and potential determinants of the injuries and fatalities.

Table 3. Haddon's matrix of an accident on National Highway No. 41, Surat Thani Province, 1 Jan 2025

Period	Factor		
	Human	**Vehicle**	**Road and environment**
Pre-crash	**Drivers** - Two males aged 45 and 46 years with valid vehicle driving license class 2. - Were unfamiliar with the route. - Average speed not more than 90 km/h throughout the journey. - Attempting to overtake another vehicle ahead. - Took breaks at checkpoints along the journey every two hours. - Blood alcohol from breathalyzer was not detected. **Passengers** - None of the passengers fasten their seatbelts.	- Had been in use for 26 years. - Tires, which were produced in the 16th week of 2022, were in good condition and proportionally used with the bus size. - The latest inspection was conducted on 25 Dec 2024 and was checked at assigned points along the journey. - The bus was equipped with a GPS, seatbelts, a fire extinguisher, and a window-breaking hammer.	**Road** - Constructed with asphaltic concrete and re-opened in June 2024. - Absence of lane markings, shoulder delineations, and street lighting. - There were two lanes, separated by a depressed median. **Environment** - Many large roadside trees >10 cm in diameter were present along the roadway. - Nighttime had low visibility. No recent precipitation.
Crash	**Driver** - A 46-year-old male overtook a six-wheeled truck. - Seatbelt was fastened. - Blood alcohol and addictive substances were not detected. **Passengers** - None of the passengers fasten their seatbelts, resulting in being thrown to the right side of the bus. - The five who died at the scene all sat nearest to the site of the collision with the trees.	- Airbags were not functional. - Bus veered off to the right shoulder of the road, lost control, collided with a tree, and overturned onto its right side. - The crash speed, recorded by the GPS, was 81 km/h.	**Environment** - Three large trees >10 cm in diameter in the depressed median were struck, one of which broke. The impact caused a branch from one tree to penetrate the windshield, injuring passengers. - At nighttime, the visibility was poor. No evidence of precipitation.
Post-crash	**Drivers and passengers** - All were injured, including the drivers; five passengers were dead. - Among the 32 injured survivors, 22 green-, 8 yellow-, and 2 red-tagged*. Seven green- tagged individuals declined medical treatment. **Emergency team** - ALS transported 25 injured individuals to the hospital while the deaths were delivered by rescue teams.	- The front frame on the right side of the driver's area was severely damaged, collapsing inward into the vehicle. - The right side sustained significant damage, and the windows were shattered along the entire length. - The front and rear wind-shields were shattered. - Some passenger seats became detached from their bases.	- The foundation rescue team arrived within 4 minutes of the report and coordinated with additional hospital support teams. - The ALS from Chaiya Hospital, which is approximately 7 km from the scene, arrived within 10 minutes. - All cases were referred from the scene and arrived at the hospital by 9:25 PM, 2 hours after receiving notification.

**Tagged colors: Red (immediate)—cannot survive without immediate treatment but has a chance of survival; Yellow (urgent)—requires observation. Condition is stable and not in immediate danger of death; Green (delayed)—the "walking wounded" who will need medical care after more critical injuries have been treated. ALS: Advanced life support. GPS: Global positioning system. km/h: kilometers/hour. cm: centimeters.*

Action Taken

The relevant authorities convened to assess risks and propose countermeasures for improving road safety. They reached a consensus on accelerating safety improvement, including the installation of reflective signs and flashing lights before the accident site and marking lane lines between the Pa We District and Chaiya Intersection. Additionally, the Department of Highway, Tha Chang Office will present and propose road safety measures for the roads under construction to the national committee. As part of the immediate plan, this proposal includes installing a guardrail or barriers at the curve preceding the accident site. Furthermore, the Road Safety Operations Center Committee of Surat Thani Province invited related organizations to review and extract lessons learned from this mass casualty incident. A multidisciplinary approach will be a core function to enhance the incident command system and improve response strategies.

Discussion

We investigated a tour bus accident on National Highway No. 41 in Surat Thani Province, Thailand, examining its causes and consequences, including injury severities and fatalities. Although motorcycle accidents are more common, accidents involving cars or buses can result in numerous injuries and deaths.[2]

Of the 37 accident victims, there were five deaths, and all died at the scene. The causes of death were massive intra-abdominal hemorrhage, cervical spine fracture, and severe head injuries. The fatalities were observed in passengers who sat closest to the collision points with the trees. It is well-documented that occupants seated on the side of impact in a vehicle exposed to a side collision with fixed objects such as massive trees are vulnerable due to limited space, increasing the severity of injury.[8] Moreover, the lack of seatbelt use worsened the outcomes, as passengers were thrown from their seats, increasing the force of impact. This finding is consistent with another study that found proper seatbelt use could reduce injury severity by half.[9,10] Among the survivors of this accident, the most common site of injury was the extremities, followed by the thorax, consistent with another study.[11]

Multiple factors contributed to this accident. A significant finding was the driver's unfamiliarity with the route. This is consistent with a report of drivers on unfamiliar roads and traffic crashes, which found that drivers unfamiliar with a road have an increased likelihood of a crash.[12] While driving under the influence of alcohol or addictive substances is often associated with accidents, neither alcohol nor addictive substances contributed to this accident, suggesting that environmental factors played a predominant role.[13]

The absence of lane markings, shoulder delineations, and road lighting were contributing factors for this accident, consistent with another study, the absence of these visual guides can result in driver confusion, loss of position recognition, reduced reaction times, and increased in the risk of run-off-road crashes.[14] Furthermore, the presence of fixed objects along the road, such as roadside trees, increased the severity of accidents. Many trees on this stretch of road had trunk diameters exceeding 10 centimeters. A study from Czechia found that for every increase in a tree's diameter by 10 centimeters, the probability of serious injury and death increased by 1.74 and 1.97 times, respectively.[15] Moreover, trees with trunks over 10 centimeters in diameter are roadside hazards and should not be planted within five meters of a road.[16,17]

Although all injured passengers were evacuated from the scene within two hours, initial delays in command, control, and coordination highlighted the need for a better-prepared response system during emergencies. Prompt command at the scene and coordination of multi-agency responses can potentially reduce fatalities.[18]

Limitations

One significant limitation was the lack of complete data on the use of seatbelts among all passengers, as some individuals declined to participate in the interview due to the psychological trauma caused by the accident. Therefore, witnesses from medical records and rescue team interviews were combined to infer seatbelt use. This reliance on secondary data may have affected the accuracy of our results.

Recommendations

The Surat Thani Disaster Prevention and Mitigation Office should conduct a functional exercise on scene management, particularly for mass casualty incidents. This training should involve key organizations such as the Emergency Medical Service Command and Control Center and the Surat Thani Provincial Public Health Office, with a focus on foundation rescue teams. Moreover, the Department of Highways may need to consider tree removal as there have been many studies suggesting that single vehicle collisions with trees exceeding 10 centimeters in diameter can increase the risk of fatality. The Department of Highways should consider installing delineation or guiding signals in areas considered at high-risk of crashes, such as roads under construction.

Conclusion

A side-single collision between a tour bus and roadside trees on National Highway No. 41 in Surat Thani Province, caused by the driver losing control of the vehicle, resulted in five fatalities at the scene and 32 injured survivors. Key determinants were the driver's unfamiliarity with the route and unsafe road environment, including a lack of lane markings, shoulder delineations, and road lighting. Various factors contributed to the severity of the injuries and fatalities, including the passenger's non-use of seatbelts. The collision involved three large trees, each exceeding 10 centimeters in diameter, in the highway's depressed median, which was sloped at an angle of 40 degrees, causing the bus to tip over on its side, escalating the impact as gravitational force was combined with the bus's mass and velocity. We recommend that the road safety environment should be improved, especially on roads that are under construction. Roadside tree management should be included in the national plans. Exercises on emergency scene management involving command and coordination should be undertaken as a multi-disciplinary approach.

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Conflicts of Interest

The authors declare no conflict of interest.

Suggested Citation

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References

1. World Health Organization. Road traffic injuries [Internet]. Geneva: World Health Organization; 2023 Dec 13 [cited 2025 Jan 6]. <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries>
2. World Health Organization. The Global status report on road safety 2023. 1st ed. Geneva: Bloomberg Philanthropies; 2023.
3. World Health Organization in Thailand. Road Safety [Internet]. Nonthaburi: WHO Country Office for Thailand; 2025 [cited 2025 Jan 6]. <https://www.who.int/thailand/our-work/road-safety>
4. Division of Injury Prevention, Department of Disease Control (TH). *Documents and Related Official Directives* [Internet]. Nonthaburi: Division of Injury Prevention, Department of Disease Control; 2022 [cited 2025 Jan 2]. <http://ddc.moph.go.th/dip/pagecontent.php?page=795&dept=dip>
5. Department of Emergency Medicine, Khon Kaen Hospital. Medical management in disaster [Internet]. Khon Kaen (TH): Khon Kaen Hospital; 2020 [cited 2025 Jan 8]. <https://em.kkh.go.th/knowledge/diasater01.html>. Thai.
6. Haddon W Jr. A logical framework for categorizing highway safety phenomena and activity. J Trauma. 1972 Mar;12(3):193–207. doi:10.1097/00005373-197203000-00002.
7. Petridou ET, Antonopoulos CN. Injury Epidemiology. 2nd ed. In: Quah SR, editor. International Encyclopedia of Public Health. Oxford: ScienceDirect; 2017. p. 258–74.
8. Augenstein J, Perdeck E, Bowen J, Stratton J, Singer M, Horton T, et al. Injuries in Near-Side Collisions. Proceedings of the 43rd Association for the Advancement of Automative Medicine; 1999 Sep 20–21; Barcelona (Sitges), Spain. Chicago (IL): Association for the Advancement of Automotive Medicine; [1999]. p. 139–58.
9. Ogundele OJ, Ifesanya AO, Adeyanju SA, Ogunlade SO. The impact of seat-belts in limiting the severity of injuries in patients presenting to a university hospital in the developing world. Niger Med J. 2013 Jan;54(1):17–21. doi:10.4103/0300-1652.108888.
10. Cummins JS, Koval KJ, Cantu RV, Spratt KF. Do seat belts and air bags reduce mortality and injury severity after car accidents? Am J Orthop (Belle Mead NJ). 2011 Mar;40(3):E26–9.

11. Bjornstig U, Bylund P, Albertsson P, Falkmer T, Bjornstig J. Injury events among bus and coach occupants: non-crash Injuries as Important as crash injuries. IATSS Research. 2005;29(1): 79–87. doi:10.1016/S0386-1112(14)60121-7.

12. Sivak M, Schoettle B. Drivers on unfamiliar roads and traffic crashes [Internet]. Ann Arbor (MI): University of Michigan; 2010 Dec [cited 2025 Jan 15]. <https://deepblue.lib.umich.edu/bitstream/handle/2027.42/78448/102704.pdf>

13. Lin H, Chan C, Wiratama BS, Chan PL, Wang MH, Chao CJ, et al. Evaluating the effect of drunk driving on fatal injuries among vulnerable road users in Taiwan: a population-based study. BMC Public Health. 2022 Nov 10;22(1):2059. doi:10.1186/s12889-022-14402-3.

14. Lopez G, Ona JD, Garach L, Baena L. Influence of deficiencies in traffic control devices in crashes on two-lane rural roads. Accid Anal Prev. 2016 Nov;96(5):130–9. doi:10.1016/j.aap.2016.08.008.

15. Bucsuhazy K, Zuvala R, Valentova V, Ambros J. Factors related to severe single-vehicle tree crashes: In-depth crash study. PLoS One. 2022;17(1):e0248171. doi:10.1371/journal.pone.0248171.

16. Central Asia Regional Economic Cooperation Program. CAREC road safety engineering manual: roadside hazard management [Internet]. Manila: Asian Development Bank; 2018 Apr [cited 2025 Mar 3]. <http://dx.doi.org/10.22617/TIM179174-2>

17. Chatngoen T, Saeaui P, Choosri N, Chattrawongwiwat T, Sangsawang C, Phiriyasart F, Jiraphongsa C. An investigation of double collisions of pickup trucks with multiple fatalities in Narathiwat Province, Thailand, October 2023. OSIR. 2024 Jun;17(2): 87–96. doi:10.59096/osir.v17i2.268926.

18. Cole D. The incident command system: a 25-year evaluation by California practitioners [Internet]. Hyattsville (MD); Federal Emergency Management Agency (US): 2000 [cited 2025 Jan 15]. 230 p. <https://apps.usfa.fema.gov/pdf/efop/efo31023.pdf>