One Hundred Years of Railway Disasters and Recent Trends

Rebecca Forsberg, RN, BSc; Ulf Björnstig, MD, PhD

Department of Surgical and Perioperative Sciences, Division of Surgery, Umeå University, Umeå, Sweden

Correspondence:
Rebecca Forsberg RN, Ph.D student
Department of Surgical and Perioperative Sciences, Division of Surgery/KBC
Umeå University
SE- 901 87 Umeå
Sweden
E-mail: rebecca.forsberg@surgery.umu.se

Keywords: Accident, Collision; Crash; Derailment; Disaster; Incident; Injured; Killed; Mass casualties; Passenger; Rail; Railway; Railroad; Safety; Train.

Abbreviations:
CRED = Centre for the Research on the Epidemiology of Disasters
EM-DAT = Emergency Events Database

Received: 14 June 2010
Revised: 23 July 2010
Accepted: 11 October 2010

Online publication: 21 September 2011

doi:10.1017/S1049023X1100639X

Abstract

Introduction: Globally, railway transport is increasing steadily. Despite the adoption of diverse safety systems, major railway incidents continue to occur. Higher speeds and increased passenger traffic are factors that influence the risk of mass-casualty incidents and make railway crashes a reality that merits extensive planning and training.

Methods: Data on railway disasters were obtained from the Centre for Research on the Epidemiology of Disasters (CRED), which maintains the Emergency Events Database (EM-DAT). This descriptive study consists of 529 railway disasters (≥10 killed and/or ≥100 non- fatally injured) from 1910 through 2009.

Results: The number of railway disasters, people killed, and non-fatally injured, has increased throughout the last hundred years—particularly during the last four decades (1970–2009), when 88% of all disasters occurred. In the mid-20th century, a shift occurred, resulting in more people being non-fatally injured than fatally injured. During 1970–2009, 74% of all railway disasters occurred in Asia, Africa, and South and Central America, combined. The remaining 26% occurred in Europe, North America, and Oceania, combined. Since 1980, railway disasters have increased, especially in Asia and Africa, while Europe has had a decrease in railway disasters. The number killed per disaster (1970–2009) was highest in Africa (n = 55), followed by South and Central America (n = 47), and Asia (n = 44). The rate was lowest in North America (n = 10) and Europe (n = 29). On average, the number of non-fatal injuries per disaster was two to three times the number of fatalities, however, in the African countries (except South Africa) the relation was closer to 1:1, which correlates to the relation found in more developed countries during the mid-20th century. The total losses (non-fatally and fatally injured) per disaster has shown a slight decreasing trend.

Conclusions: Despite extensive crash avoidance and injury reduction safety systems, railway crashes occur on all continents, indicating that this type of incident must be accounted for in disaster planning and training. Better developed safety, crashworthiness, and rescue resources in North America and Europe may be factors explaining why the number of crashes and losses has stabilized and why the average number of people killed per disaster is lowest on these continents.

Forsberg R, Björnstig U: One hundred years of railway disasters and recent trends. *Prehosp Disaster Med* 2011;26(5):367–373.

Introduction

During the second half of the 19th century, railway passenger traffic began, and there were few major injury incidents because of limited traffic and low speeds.[1] The railroad system underwent further technical and safety development during the 20th century, especially during the second half of the century. Over the last decades, train speeds have increased[2] in many countries, and new high-speed lines (>250 km/h; 155 mph) are inaugurated frequently throughout the world.[3,4] Currently, several trains operate at 300 km/h (186 mph).[5] The Maglev (magnetic levitation) Transrapid train in Shanghai operates in regular traffic at speeds up to 430 km/h (267mph).[6]

Because of today's high speeds, severe damage and injuries are to be expected in a crash.[7–20] Further complications can arise because crashes may happen in remote areas without access to roads and with limited rescue resources. Unprepared/untrained personnel may experience difficulties while managing these events. Some studies have shown that such shortcomings have caused a number of "avoidable deaths".[7,21] Rail passenger traffic will continue to increase along with higher speeds and more passengers. The

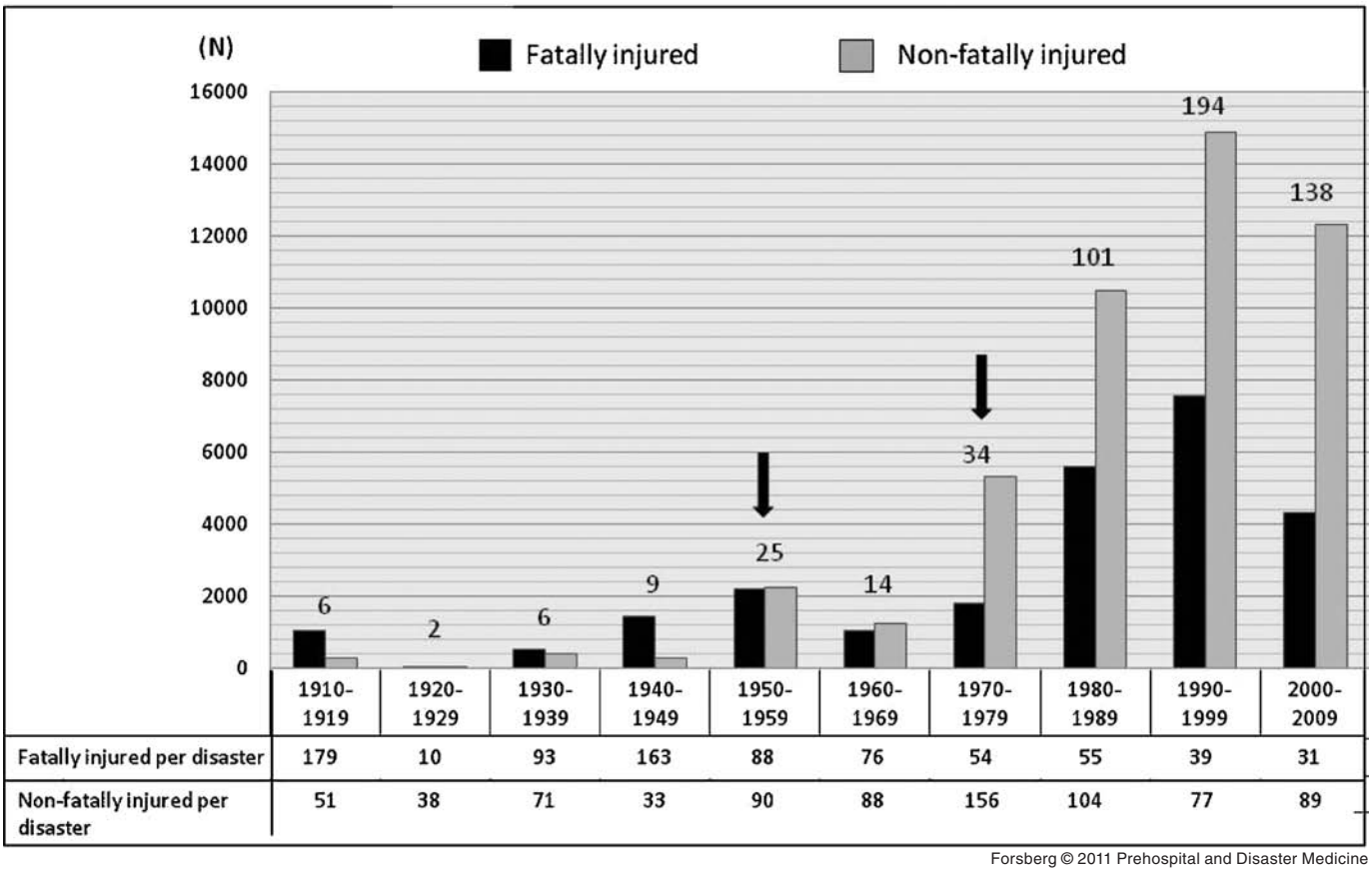

Figure 1—Number of fatally and non-fatally injured per disaster during 1910–2009 and the number of railway disasters (figure above the columns). The arrows indicate important shifts in train constructions and safety implementations.

complex nature of responding to such events makes pre-event planning and training essential. As a basis for planning and training in different continents and countries, this study aims to shed light on the magnitude and development of passenger rail crashes over the years in various continents and countries.

Methods

A 100-year dataset, from 1910–2009 was made available from the Centre for Research on the Epidemiology of Disasters (CRED), which maintains the Emergency Events Database (EM-DAT), a worldwide database on disasters. Disasters included in this study were selected on two of CRED's criteria defining a disaster:[22] 10 or more people reported killed and/or; ≥100) or more people reported affected.

Events caused by intentional acts were excluded from the database. Within the criterion "affected", a further sample specification was made to include only events resulting in ≥100 non-fatally injured victims. A total of 529 railway crashes were included. Of these 529 incidents, six were subway disasters and one was a Maglev disaster. Supplementary data also have been collected via different scientific and Internet sources using suitable keywords. Additionally, transport literature and media, including films and documentaries, were analyzed.

The EM-DAT categorizes the world into five continents (Europe, Asia, Africa, Americas, and Oceania). Because of socio-demographic reasons, the American continents were divided into "North" (USA and Canada) and "South and Central America", respectively.

EM-DAT Data Inclusion Methodology

The EM-DAT database is compiled from various sources, including United Nations (UN) agencies, non-governmental organizations insurance companies, research institutes, and press agencies. The CRED has established a method of ranking these sources according to their ability to provide trustworthy and complete data. The disaster occurrence, in terms of fatalities, injuries, or affected only is entered into the EM-DAT if at least two sources report exact values. Priority is given to data from UN agencies, followed by the Office of Foreign Disaster Assistance governments, the International Federation of Red Cross and Red Crescent Societies. This prioritization is not only a reflection of the quality or value, of the data, but also reflects the fact that most reporting sources do not cover all disasters, or may have political limitations that may affect the figures. The record is validated before final figures and relevant information is available to the public three months later. Annual revisions are also made one, two, and sometimes three years after the event.[23]

Results

100 Years

Railway disasters were relatively infrequent (23/529; 4%) during 1910–1949. During the following two decades (1950–1969), the rate began to increase, 39 of the 529 (7%) disasters occurred during these two decades (Figure 1). Since the 1970s, the number of railway disasters (n = 467; 88%), as well as the number of fatally and non-fatally injured, has increased. The highest rates are found during the last three decades (1980–2009). The average

https://doi.org/10.1017/S1049023X1100639X Published online by Cambridge University Press

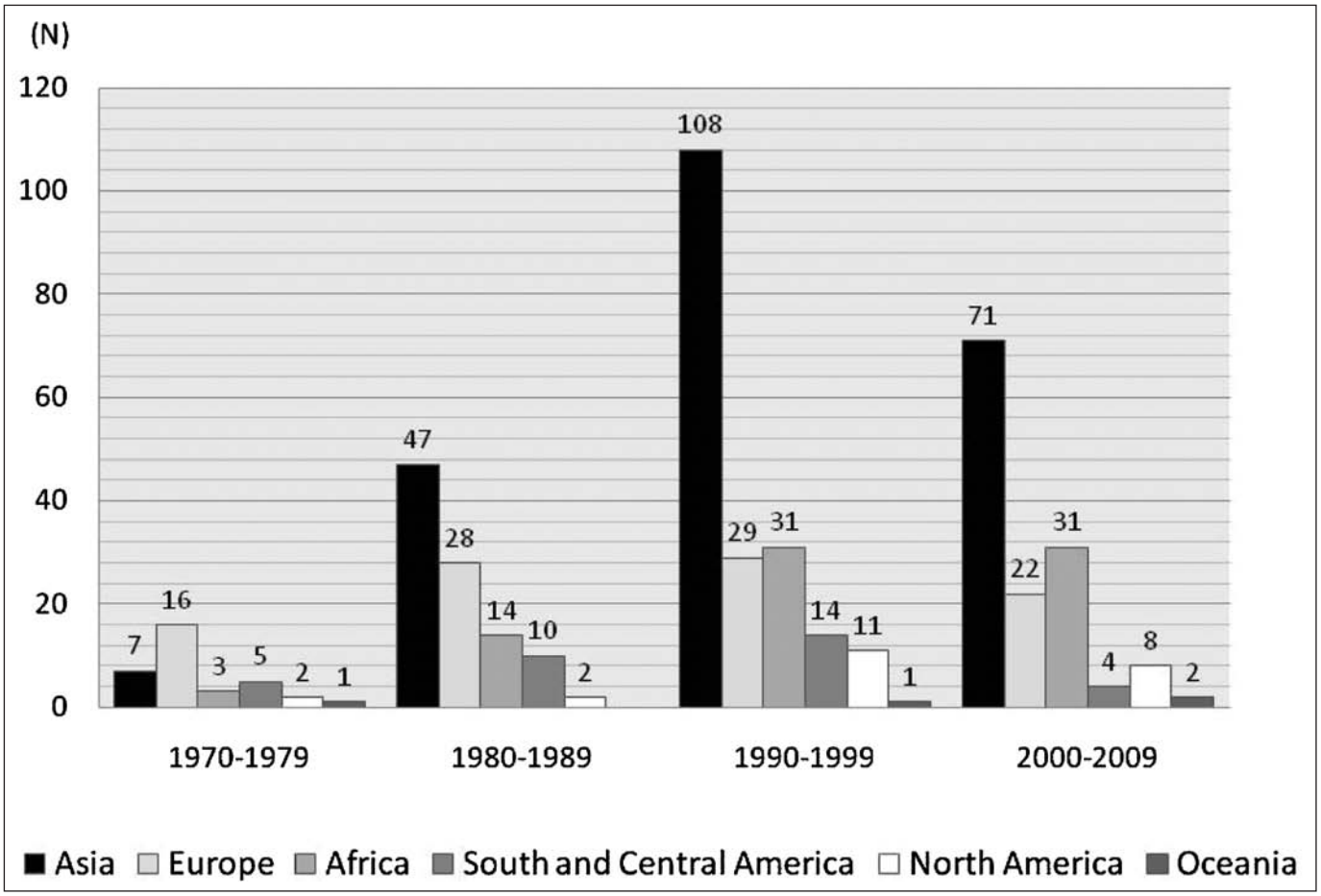

Figure 2—Number of railway disasters during 1970–2009 classified by continent

number of passengers killed per railway disaster was 135 during 1910–1949; 84 during 1950–1969; and 41 between 1970–2009. The number of non-fatally injured people per disaster during the different time periods has been 48, 89, and 92, respectively. During 1910–1949, the number of non-fatally injured was only 0.4 times the number of deaths, but during the 1950s and 1960s, the number of non-fatally injured was about the same (1.1) as the number of deaths. From the 1970s, the number of non-fatally injured has averaged 2.2 times the number of deaths (Figure 1). The variation in total number of fatally and non-fatally injured per disaster has shown a slight decreasing trend; 184, 173, and 133, respectively for the three time periods.

Distribution by Continents and Countries 1970–2009

Disasters in Different Continents—Of 467 railway disasters during the last four decades (1970–2009), the highest reported number (n = 233; 50%) occurred in Asia, followed by Europe (n = 95; 20%), Africa (n = 79; 17%), South and Central America (n = 33; 7%), North America (n = 23; 5%), and Oceania (n = 4; 1%). In the 1970s, Europe reported the highest frequency, but since the 1980s, Asia has had the highest number per decade. During the 1990s, Africa has surpassed Europe and ranked in the last two decades (Figure 2).

The highest number of fatalities from 1970–2009 (10,298 of 19,348; 53%) occurred in Asia, followed by Africa (4,361; 23%), Europe (2,784; 14%), South and Central America (1,562; 8%), North America (237; 1%), and Oceania (106; 1%). In terms of fatally and non-fatally injured (losses), Asia, Africa, and Europe reported the highest losses, but the development in different continents were different during the period 1970–2009. Asia, Africa, and North America had an increase in losses (except for the last decade in which the upward trend declined slightly), and South and Central America reported a decrease in losses. Europe and Oceania showed only minor changes (Table 1).

In terms of number of people killed, Africa experienced an increase of 198% (1,095 vs. 3,266) between the first and second half of the period, 1970–2009, Asia had an increase of 107% (3,359 vs. 6,939), and North America 32% (102 vs. 135). On the contrary, South and Central America had a decrease of 56% (1,086/= vs. 476) and Europe had a 37% reduction in the number of killed (1,705 vs. 1,079). The average fatality rate per event was highest in Africa (55), followed by South and Central America (47) and Asia (44), while it was only 29 in Europe, 27 in Oceania, and 10 in North America.

In terms of non-fatally injured, the increase for the years 1970–1989, compared with 1990–2009, was 321% (621 vs. 2,615) in North America, 154% (1,863 vs. 4,740) in Africa and 154% (6,198 vs. 15,714) in Asia. A decrease of 76% (3,325 vs. 798) was reported from South and Central America and 16% (3,696 vs. 3,110) from Europe.

https://doi.org/10.1017/S1049023X1100639X Published online by Cambridge University Press

		1970–1979		1980–1989		1990–1999		2000–2009	
		Total	Mean per disaster	Total	Mean per disaster	Total	Mean per disaster	Total	Mean per disaster
Asia	Fatal injured	333	48	3,026	64	4,674	43	2,265	32
	Non-fatally injured	1,122	160	5,076	108	8,700	81	7,014	99
Europe	Fatal injured	718	45	987	35	587	20	492	22
	Non-fatally injured	1,206	75	2,490	89	1,768	61	1,342	61
Africa	Fatal injured	115	38	980	70	1,783	58	1,483	48
	Non-fatally injured	390	130	1,473	105	2,414	78	2,326	75
South/ Central America	Fatal injured	524	105	562	56	434	31	42	11
	Non-fatally injured	1,955	391	1,370	137	485	35	313	78
North America	Fatal injured	56	28	46	23	82	7	53	7
	Non-fatally injured	550	275	71	36	1,452	132	1,163	145
Oceania	Fatal injured	83	83	--	--	12	12	11	6
	Non- fatally injured	91	91	--	--	51	51	143	72

Table 1—Number of fatal and non-fatally injured classified by decade and continent

Disasters in Different Countries—On the Asian continent, India reported the most railway disasters (104 of 233; 45%) followed by Pakistan (24; 10%). On the African continent, most disasters were reported from South Africa (12 of 79; 15%) and Egypt (12; 15%). In Europe, Russia reported most railway disasters (17 of 95; 18%) followed by the United Kingdom (13; 14%). In South and Central America, Mexico reported more than half of all disasters (17 of 33; 52%) followed by Cuba (7; 21%). In North America, 21 (91%) of the 23 disasters happened in the US (Table 2).

Within the Asian continent, India had the highest number of people killed (4,402 of 10,298; 43%). In Africa, it was Egypt (779; 18%), in Europe, it was Russia (591; 21%), in South and Central America, it was Mexico (837; 54%) and for North America, it was the US (205; 86%). The fatality rate per disaster, nonetheless, differs within the continents. South Africa had the highest number of reported railway disasters (n = 12) tied with Egypt (n = 12) in Africa, but South Africa had a notably lower rate of average number of people killed per disaster (n = 17) compared to Angola (n = 300) and Ethiopia (n = 131). Azerbaijan (n = 337), and North Korea (n = 121) had the highest number killed per disaster within the Asian continent. Japan had 33 killed per disaster, close to the average for Asia. In Europe, it was Austria (n = 80) and Portugal (n = 70). Within the South and Central American continent, Brazil (n = 74) and Chile (n = 62) had the highest average killed. In North America, Canada and the US had 16 and 10, respectively (Table 1).

Discussion

The safety measures and systems introduced, especially during the last 3–4 decades, have not reduced the number of railway disasters, even though Fothergill *et al*[9] have noted the crash-reducing effects of better signaling and other safety systems. In countries with rail traffic, it seems wise to plan and train for the needed complex responses and to prepare efficient cooperation with all other involved agencies; implementing what Oestern *et al*[12] recommended after the 1998 high-speed train crash in Eschede.

Railway disasters were relatively rare before 1970, as only 12% of the disasters occurred during the first six decades of the study period. This was probably due to lower speeds and less passenger-kilometers traveled. Those passengers involved, however, more often suffered fatal injuries, as the rail carriages were made of wood. In a crash, the wooden carriages disintegrated in a manner called "telescoping" (Figure 3). Additionally, the crashes were more commonly complicated by fire[24,25] and rescue techniques and resources may have been limited. The number of

https://doi.org/10.1017/S1049023X1100639X Published online by Cambridge University Press

Continent	No. of Disasters	No. of Killed	No. of Killed per disaster	No. of Non-fatally injured	No. of Non-fatally injured per disaster
Asia	**233**	**10298**	**44**	**21912**	**94**
India	104	4402	42	6224	60
Pakistan	24	1223	51	2335	97
China	20	1442	72	3137	157
Indonesia	20	567	28	1108	55
Bangladesh	15	492	33	2732	182
Other	50	8126	–	–	–
Europe	**95**	**2784**	**29**	**6806**	**72**
Russia	17	591	35	871	51
United Kingdom	13	220	17	1849	142
Germany	12	338	28	773	64
France	8	304	38	490	61
Italy	8	164	21	737	92
Other	37	1167	–	–	–
Africa	**79**	**4361**	**55**	**6603**	**84**
South Africa	12	200	17	1310	109
Egypt	12	779	65	908	76
Mozambique	5	462	92	539	108
Congo Kinshasa	8	345	43	169	21
Tanzania	5	366	73	480	96
Other	37	2209	–	–	–
South and Central America	**33**	**1562**	**47**	**4123**	**125**
Mexico	17	837	49	2413	142
Cuba	7	197	28	688	98
Brazil	5	368	74	209	42
Argentina	3	98	33	349	116
Chile	1	62	62	464	464
North America	**23**	**237**	**10**	**3236**	**141**
United States	21	205	10	3035	145
Canada	2	32	16	201	101
Other	0	0	–	–	–
Oceania	**4**	**106**	**27**	**285**	**71**
Australia	4	106	27	285	–
Other	–	–	–	–	–
Total	**467**	**19348**			

Table 2—Number of railway disasters "top five" in different continents and countries during the last decade (1970–2009)

https://doi.org/10.1017/S1049023X1100639X Published online by Cambridge University Press

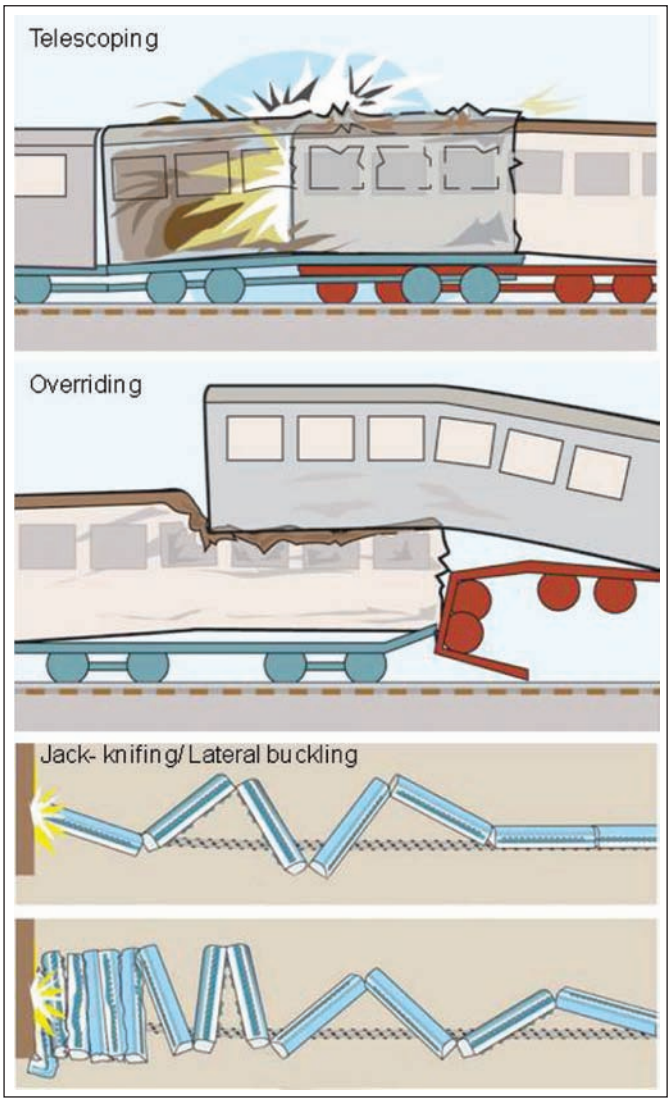

Figure 3—(Color online) Different crash-phenomena: Telescoping, overriding, and jack-knifing/lateral buckling. (Illustrator: Gunilla Guldbrand)

deaths per disaster was highest prior to 1950 (135), but decreased to 41 after 1970, indicating an improvement in safety, crashworthiness, and rescue efficiency.

During the 1950s, metal carriages replaced most wooden carriages. Metal carriages absorbed the kinetic energy better than those made of wood, and therefore, emerged from a crash relatively intact. After the 1950s, the ratio of non-fatally injured to the number of fatalities started to increase. Although metal carriage design minimized the telescoping problem, it inadvertently created another dangerous phenomenon called "overriding" (Figure 3). This is when one carriage overrides another and crashes down on the passengers below. Corrugated metal plates known as "anti-climb" devices and crash-zones later were introduced to minimize this risk. However, a new phenomenon called "jack-knifing", or lateral buckling (Figure 3), developed. Upon impact, the train carriages derail and collide into each other's sides, resulting in the carriage sidewalls collapsing inward, injuring the passengers.[26]

Because the last two crash phenomena currently are the most common worldwide, they would be the basis for developing a suitable tactical approach to overcome the special rescue and evacuation complications.[12,19,27,28] The lack of heavy rescue equipment also has been as a significant problem, as emphasized by several authors.[13,20] Further, Nagata *et al* emphasized the need for training in confined-space-medicine, since this was a lifesaving tactic used for trapped victims in the 2005 crash in Amagasaki, Japan.[13] Moreover, Hambeck *et al*[7] and Robinson[21] demonstrated the need for rapid extrication of the injured. They found that a number of victims might have survived if they had been extricated more quickly. Additionally, interior design and baggage stowage have been reported to interfere with injury panorama[9,15,18,27,29–31] and rescue procedures.[18,20]

Examining the last four decades (1970–2009) more closely, the number of railway disasters, as well as the number of fatalities and non-fatal injuries, has increased despite all safety measures implemented. (cf. air traffic—the number of fatalities has decreased to 1/5 during the same time period). Factors related to this increase may be more passenger-kilometers traveled, more passengers inside each train carriage, and higher speeds. Improvements in crash safety probably contributed to the relation between fatal and non-fatal injuries shifting after 1970 to 1:2.2. Even when the number of fatalities per disaster consistently decreased, the number of non-fatal injuries per disaster has not decreased.

Older trains were engine-powered and oversized; they did not have passengers in the first carriage (engine). In contrast, modern interchanged multiple-unit trains carry passengers in the first carriage, exposing them to greater risks.[7,10,20,32] Moreover, they are built of stainless steel or aluminum, making them less robust. On the other hand, these newer trains include deformation zones providing an added element of safety that did not exist on older trains.

It was noted that Asia (2010 billion passenger-kilometers), especially India (838 billion passenger-kilometers), reported the most rail passenger-kilometers traveled in 2009 as well as prior years.[33] This partially may explain why most railway disasters, nowadays, happen in this region. Compared with other regions, the lower safety standards and train crashworthiness of several countries in Asia, Africa, and Central and South America are important factors resulting in high rates of fatalities per disaster to which overcrowded trains carrying passengers on the roofs and hanging out through windows contribute. Passengers riding in these manners may be predisposed to major injuries. Window bars and locked doors, as used in some regions, can be factors aggravating an incident especially when there is fire involved. The bars and locks not only make it difficult to exit the carriages, but may also hamper rescue operations.

Limitations

Information systems have improved immensely over the last decades and data are now more easily assessable and reliable.[34] Because only severe railway incidents (≥10 killed and/or ≥100 people non-fatally injured) are included in this study, the number of missed disasters is probably low.

Train disasters caused by intentional antagonistic acts such as terrorist attacks and warfare are not included in this database. Even so, in a few cases of the selection procedure, it might have

been difficult to ascertain whether the disaster was intentionally caused or not.

Changes in national boundaries can cause ambiguities; most notably, the break-up of the former Soviet Union and the former Republic of Yugoslavia, and the reunification of Germany.[34] Therefore, up-to-date boundaries have been used.

Comparison of passenger-kilometers traveled in different continents and regions is made with the knowledge that only International Union of Railways (UIC) members are represented in the statistics. Therefore, the number of kilometers traveled should be considered as approximate.

Conclusions

The trends identified indicate that the crash avoidance and safety measures worldwide have not been able to reduce the number of railway disasters, making this a reality requiring planning and training in many countries. High-speed rail constructions will place new demands on the tactics, techniques, and equipment used by rescue personnel. These elements are the basis for good disaster preparedness. Measures to facilitate rescue and escape routes, especially in overturned carriages, would be valuable. Furthermore, safer interior design and safer baggage stowage would have a potential to reduce injuries and to facilitate rescue and evacuation.

Acknowledgements

The authors thank CRED for providing the data, the Swedish National Board of Health and Welfare, the European Regional Development Fund (ERDF), and the Swedish Civil Contingencies Agency (MSB) Sweden for financial support and valuable information about railway safety issues. We also express our appreciation to the language revisers, Loren Gill and Michael Haney for reviewing the manuscript.

References

1. Brandsjö K: Disasters and Rescue Efforts. (in Swedish) *Katastrofer och Räddningsinsatser.* Stockholm: Informationsförlaget., 1996, pp 159–176.
2. International Union of Railways (UIC): Evolution of maximum speed on rails. Available at http://www.uic.org/IMG/pdf/1-6-3_20090915_UIC_High_Speed_Evolution_of_maximum_speed_on_rails.pdf. Accessed 05 May 2010.
3. UIC: High speed lines in the world- May 2010. Available at http://www.uic.org/IMG/pdf/20100521_a1_high_speed_lines_in_the_world.pdf. Accessed 27 May 2010.
4. UIC: **High Speed Lines in the world_Maps_May2010.** Available at http://www.uic.org/IMG/pdf/20100521_d_high_speed_lines_in_the_world_maps.pdf. Accessed 26 May 2010.
5. UIC: **20100420_Data of HS_Trains_Photos.** Available at http://www.uic.org/IMG/pdf/20100428_data_of_hs_trains_photos_.pdf. Accessed 26 May 2010.
6. China.org.cn: Maglev finally given approval. Available at http://www.china.org.cn/china/national/2008-08/18/content_16258686.htm. Accessed 08 August 2011.
7. Hambeck W, Pueschel K: Death by railway accident: incidence of trumatic asphyxia. *J Trauma* 1981;21:28–31.
8. Smiley AM: The Hinton train disaster. *Accid Anal Prev* 1990;22:443–455.
9. Fothergill NJ, Ebbs SR, Reese A, Partridge RJ, Mowbray M, Southcott RDC, Hashemi K: The Purely train crash mechanism: injuries and prevention. *Arch Emerg Med* 1992;9:125–129.
10. Prabhakar T, Sharma Y: Ghaisal train accident. *Indian J Anaesth* 2002;46: 409–413.
11. Howells NR, Dunne N, Reddy S: The casualty profile from the Reading train crash, November 2004: Proposals for improved major incident reporting and the application of trauma scoring systems. *Emerg Med J* 2006;23:530–533.
12. Oestern HJ, Huels B, Quirini W, Pohlemann T: Facts About the disaster at Eschede. *Journal of Orthopaedic Trauma* 2000;14:287–290.
13. Nagata T, Rosborough SN, VanRooyen MJ, Kozawa S, Ukai T, Nakayama S: Express railway disaster in Amagasaki: A review of urban disaster response capacity in Japan. *Prehosp Disaster Med* 2006;21:345–352.
14. Malik ZU, Pervez M, Safdar A, Masood T, Tariq M: Triage and managemant of mass casualties in a train accident. *JCPSP* 2004;14:108–111.
15. Madsen CF: Can injuries caused by train crash be prevented? Experiences from the train crash in Jelling in 1995. (in Danish) *Ugeskrift for laeger* 1998;160:7126–7129.
16. Alm A: Train disaster outside Mjölby. (in Swedish) *Tågkatastrofen utanför Mjölby. Läkartidningen* 1975;72:2767–2772 .
17. Assa A, Landau DA, Barenboim E, Goldstein L: Role of air-medical evacuation in mass-casualty incidents—A train collision Experience. *Prehosp Disaster Med* 2008;24:271–276.
18. Braden GE: Aircraft-type crash injury investigation of commuter train collision. *Aviat Space Environ Med* 1975;46:1157–1160.
19. Stevens KLH, Partridge R: The Clapham rail disaster. *Injury* 1990;21:37–40.
20. Weyman A, O`Hara R, Jackson A: Investigation into issues of passenger egress in Ladbroke Grove rail disaster. *Appl Ergon* 2005;36:739–748.
21. Robinson OJ: Moorgate tube disaster. Part 2. Clinico-pathological review. *BMJ* 1975; 3:729–731.
22. Centre for Research on the Epidemiology of Disasters (CRED): The International Disaster Database—EM-DAT: Criteria and Definition. Available at http://www.emdat.be/criteria-and-definition. Accessed 26 May 2010.
23. Centre for Research on the Epidemiology of Disasters (CRED): The International Disaster Database—EM-DAT: Explanatory Notes. Available at http://www.emdat.be/guidelines. Accessed 05 January 2009.
24. Kichenside G (eds): *Great Train Disasters.* Bristol: Parragon. 1997, pp 17–94.
25. History Channel: Great Train Disasters DVD. A&E Television Networks, 2008.
26. Björnstig U, Forsberg R: Transportation Disasters. In: Koenig KL, Schultz CH (eds), *Disaster Medicine: Comprehensive Principles and Practices.* New York: Cambridge University Press, 2010, pp 261–267.
27. Braden G: Application of commercial aircraft accident techniques to a railroad derailment. *Aerospace Medicine* 1974;7:772–779.
28. Cooksey A: A report of the collision that occurred on the 8 January 1991 at Cannon Street Station. Health & Safety Executive - HSE. London, 1992.
29. Cugnoni HL, Fincham C, Skinner DV: Cannon Street rail disaster—Lessons to be learned. *Injury* 1994;25:11–13.
30. Ilkaer LB, Lind T: Passengers injuries reflected carriage interior at the railway accident in Mundelsturp, Denmark. *Accid Anal Prev* 2001;33:285–288.
31. Eriksson A, Ericsson D, Lundström NG, Thorson J: Bodily injury at train derailments—Suggestion to risk limiting measures (in Swedish). Personskador vid tågurspårningar—Förslag till riskbegränsande åtgärder. *Läkartidningen* 1984;81:352–354.
32. Swedish Accident Investigation Board: Report RJ 2006:1 Collission between truck and train with a secondary train derailment in Nosaby, M County the 10th of September (in Swedish). Rapport RJ 2006:1 Kollision mellan lastbil och tåg med påföljande tågurspåring i Nosaby, M län den 10 september 2004. Available at http://www.havkom.se/virtupload/reports/111403890_rj2006_01.pdf. Accessed 28 May 2010.
33. UIC: Synopsis 2009. Available at http://www.uic.org/spip.php?article1347. Accessed 24 May 2010.
34. Guha-Sapir D, Below R, Hoyois P: Data on disasters: Easier said than done. *Disaster & Development* 2006;1:155–163.