Appendix 7. Narrative presentation of included incidents.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Study (references)** | **Origin** | **Year** | **Type of paper** | **Dead/injured** | **Major incident/disaster description, communication issues** |
| Ackermann et. al | Germany | 2010 | Case report | 21/500+ | The Love Parade in Duisburg, Germany in 2010, was a MI as the result of very limited access, lacking contingency plans for escape routes and failing inter-authority coordination causing panic among the estimated 200 000 to 1 400 000 spectators. Communication issues were breakdown due to system overload and compromised command & control as the result of that. |
| Björnstig et al. | Sweden | 2011 | Case report | 30/355 | Describes six buss crashes in Sweden, killing thirty people and injuring 355. A pattern of communication breakdown for unspecified reasons resulted in lost command & control and failing inter-authority cooperation. Pattern analysis and recommendations for future MI management with communication focus are provided. |
| Brismar et al. | Germany | 1988 | Case report | 70/346 | The 1988 air-show at the United States Air Force Base Rammstein in Germany is described, killing 70 and injuring 346 persons as the result of an airplane crash. Communication breakdown, unclear distinctions between military and civil jurisdiction and lacking cooperation because of that were the most important findings in the case report. The mid-air collision of three aircraft from the Italian Air Force display team Frecca Tricolore caused a crash in front of 300 000 spectators and subsequent explosions and fire caused the severe incident. |
| Brändström et al. (2006) | Indonesia | 2002 | Case report | 202/3 000+ | Described the 2002 Bali terrorist attacks in Indonesia, killing 202 and injuring more than 3 000 victims in a case report. Communication breakdown was the predominant issue, resulting in lost command & control, complicated by lacking pre-incident EMS coordination. |
| Brändström et al. (2007) | Spain | 2004 | Case report | 193/2 050 | The 2004 Madrid, Spain, terrorist train bombings. Communication breakdown resulting in lost command & control and lacking hospital coordination were the main findings in the incident, killing 193 and injuring approximately 2 050. Al-Qaeda terrorist placed ten bombs in four commuter trains near the main Atocha Central Station in the busy morning hours that simultaneously blew off within minutes. The attacks caused a massive MI response involving multiple EMS systems and several trauma centres in Madrid. |
| Buerk et al. | USA | 1980 | Case report | 85/613 | The 1980 Las Vegas, USA, MGM Grand Hotel fire. Major findings were communication breakdown due to system overload and incompatibility that compromised information flow, caused panic and the coordination of e.g., HEMS and hospital resources. |
| Butts et al. | USA | 2001 | Mixed methods study | 2 995/2 680 | The September 11th, 2001 New York, USA, World Trade Centre events were described. The prompt communication breakdown due to system overload was one important finding, yet also the alternate pathways to rectify command & control in the devastating event, killing 2 995 and injuring 2 680, were important findings. Two hi-jacked commercial aircraft were deliberately flown into the two towers of the World Trade Centre by the terrorists, causing the massive buildings to collapse afterwards. |
| Englund et al. | Norway | 2011 | Case report | 76/159 | The 2011 Oslo/Utøya, Norway, lone terrorist attacks, killing 76 people and injuring 159. The main communication issues were breakdown due to system overload, inter-authority communication system incompatibility and lacking MI communication guidelines. The perpetrator's use of a secondary incident site and the subsequent chaos and lack of resources to manage both incidents simultaneously were described in detail by the authors of the reports. |
| Gomez et al. | Spain | 2004 | Case report | 193/2 050 | The 2004 Madrid, Spain, terrorist train bombings. Communication breakdown resulting in lost command & control and lacking hospital coordination were the main findings in the incident, killing 193 and injuring approximately 2 050. Al-Qaeda terrorist placed ten bombs in four commuter trains near the main Atocha Central Station in the busy morning hours that simultaneously blew off within minutes. The attacks caused a massive MI response involving multiple EMS systems and several trauma centres in Madrid. |
| Hansen et al. | Denmark | 2019 | Case report |  8/15 | Train accident in Nyborg, Denmark in 2019. Non-intuitive guidelines for selected structures in Denmark, lack of initial training and weather phenomena such as hurricane and flooding compromised sufficient communication were highlighted. Eight people were killed and fifteen injured in the accident where a high-speed train collided with a trailer falling from a passing train. This was the only included paper to quantify MI communication in detail with affiliation times and shifts to temporary inter-authority communication channels. The focus was on the fact that the responsible authority in a previous report had already described insufficient communication abilities in Danish EMS. |
| Hardy (2013) | UK | 2013 | Case report | 0/69 | Complex road traffic incident in Sheppey, Kent, United Kingdom in 2013 in two included papers, injuring 69 people. Both intra- and inter-authority communication was lacking due to insufficient training and experience in MI management. Furthermore, communication breakdown due to both system overload/capacity and human factors. Communication breakdown is the main problem mentioned in the report. Subsequently, MI protocols and training have been enhanced. |
| Hardy et a. (2015) | UK | 2013 | Case report |  0/69 | Complex road traffic incident in Sheppey, Kent, United Kingdom in 2013 in two included papers, injuring 69 people. Both intra- and inter-authority communication was lacking due to insufficient training and experience in MI management. Furthermore, communication breakdown due to both system overload/capacity and human factors. Communication breakdown is the main problem mentioned in the report. Subsequently, MI protocols and training have been enhanced. |
| Hedelin et al. | UK | 1999 | Case report | 31/417 | Train crash near Paddington Station in London, United Kingdom, that killed 31 and injured 417, was reported by Hedelin (99) in a KAMEDO report. Command & control was compromised as the result of insufficient pre-incident preparedness plans. Resources were ample and actually in excess of needs. By demand, several communication systems were in use as alternates to breakdown due to system overload, such as landline phones, mobile phones and radios. A need for computer systems for registration and identification of victims involved was observed. |
| Heltne | Norway | 2013 | Case report |  0/66 | Fire in a tunnel in Gudvanga, Norway in 2013, injuring 66 people. Main findings were communication breakdown as the result of insufficient radio coverage inside the tunnel and inter-authority coordination issues. The complexity caused by two incident sites in neighbouring counties inflicted jurisdiction confusion and compromised intra- and inter-authority communication substantively. |
| Hu et al. | USA | 2001 | Literature review | N/A | Lessons learned from September 11th, 2001 in the United States in light of the then recent Boston Marathon bombings. Provided reflections and recommendations for future disaster management with communication focus. Operational details were not provided; however, they do represent important contributions for future MI and disaster management enhancement. |
| Huang et al. | China | 2012 | Mixed methods study | N/A | Experiences from a natural disaster in China in 2012 provided reflections and recommendations for future disaster management with communication focus. Operational details were not provided; however, they do represent important contributions for future MI and disaster management enhancement. |
| Hägnevik et al. | USA | 1993 | Case report | 6/1 000+ | The 1993 terrorist bomb attack on World Trade Centre, New York, USA, that killed six people and injured more than thousand. Lost command & control and the resulting inadequate inter-authority coordination were predominant findings. This was the first official terrorist attack on American soil by assumed Islamic extremists, trained in al-Qaeda training camp in Afghanistan. The World Trade Centre suffered substantive structural damage. |
| Iselius  | Germany | 1998 | Case report | 101/88 | The 1998 Eschede, Germany train accident, killing 101 and injuring 88 persons. The communication breakdown had actual consequences for patient management and outcome. The accident was the result of the derailing of a high-speed train at 200 km/h, crashing into a bridge that collapsed on two of the coaches. It was the result of a fatigue fracture in a wheelset of the high-speed train that prompted a change of design in the aftermath. The accident remains the worst rail disaster in Germany and the worst high-speed rail disaster in the world to date. |
| Iversen | Norway | 2011 | Case report | 0/22 | Buss rollover in Skaidi, Norway, that injured 22 people, was described in detail by Iversen (105), finding concerns on pre-incident communication setup and the use of several independent communication systems. This resulted in resource issues echoing EMCC reluctance to call in extra units and personnel, probably due to lacking shared situation awareness, caused by insufficient communication from incident site. |
| Jama  | Finland | 2007 | Case report |  8/14 | A school shooter in Jokela, Finland, killed eight and injured fourteen in 2007. The case report by Jama (106) found communication breakdown as the result of TETRA network difficulties. The beneficial effectiveness of Finnish TEMS concept was highlighted in the report. Jokela was the second school shooting in Finland after the 1989 Raumanmeri incident but was to be followed by the Kauhajoki School shooting in 2008. |
| Kapucu et al. | USA | 2001 | Consensus paper | 2 995/2 680 | The September 11th, 2001 New York, USA, World Trade Centre events were described. The prompt communication breakdown due to system overload was one important finding, yet also the alternate pathways to rectify command & control in the devastating event, killing 2 995 and injuring 2 680, were important findings. Two hi-jacked commercial aircraft were deliberately flown into the two towers of the World Trade Centre by the terrorists, causing the massive buildings to collapse afterwards. |
| Kulling et al. (1993) | Sweden/ Denmark | 1990 | Case report | 159/30 | The fire on board the ferry Scandinavian Star off Lysekil, Sweden, in 1990, killing 159 and injuring thirty. Communication issues complicated cross-nation coordination and inflicted loss of command & control and information on the destination of the surviving victims. The Scandinavian Star fire was the result of an arsonist that lit multiple fires on the ship en route from Oslo, Norway to Frederikshavn, Denmark. Blocked fire doors, insufficient initial fire drill training of the crew, lacking maintenance of essential fire equipment and an expedited inauguration of the ferry line were all contributors to the tragic incident. |
| Kulling et al. (1997) | Finland/ Sweden/ Estonia | 1994 | Case report | 852/137 | Loss of the ferry Estonia in the Baltic Sea between Finland, Sweden and Estonia in 1994, killing 852 and injuring 137. Communication issues complicated cross-nation coordination and inflicted loss of command & control and information on the destination of the surviving victims. The Estonia sank on its way from Tallinn, Estonia to Stockholm, Sweden. Causes are unclear at this point, since recent investigations as of September 2022 have demonstrated structural damage to the ship, suggesting a collision with a large object or as the result of an explosion. These findings contrast the initial conclusions of the Estonia commission that found that the loss of the bow visor due to rough sea and insufficient secure mechanism caused flooding of the car deck and the capsizing of Estonia. |
| Lavery et al. | Northern Ireland | 1998 | Case report | 29/336 | The Omagh, Northern Ireland, car bombing in 1998, killing 29 and injuring 336. Communication breakdown was the possible result of insufficient pre-incident communication setup.  |
| Palttala et al. | N/A | N/A | Questionnaire | N/A | The results of a questionnaire on gaps in disaster and MI communication provided by international MI experts and non-governmental organizations. Emphasis was pointed towards the importance of communication in disaster and MI, both in regard to command & and control in disaster management and for public outreach in the immediate and long-term aftermath from natural disasters. |
| Picazo et al. | Chile | 2010 | Case report | 81/20 | Prison fire in Santiago, Chile, killing 81 and injuring 21. The findings mirrored the need for preparedness plans to mitigate communication breakdown and loss of lives to the consequences of that. Furthermore, insufficient pre-incident EMS setup, prison crowding and the nature of the incident itself contributed to the unnecessary loss of several lives. |
| Rehn  | Norway | 2000 | Case report | 19/67 | Train accident in Åsta, Norway, in 2000 caused 19 fatalities and 67 injured persons. The case report described the obvious need for high-fidelity communication systems such as the TETRA network to enhance inter- and intra-authority communication. The report found concerns about unclear pre-incident MI management guidelines and expressed the need for a national inter-disciplinary system for MI management. This was later established. |
| Rimstad et al. | Norway | 2011 | Mixed methods study | N/A | The 2011 Oslo/Utøya, Norway, lone terrorist attacks, killing 76 people and injuring 159. The main communication issues were breakdown due to system overload, inter-authority communication system incompatibility and lacking MI communication guidelines. The perpetrator's use of a secondary incident site and the subsequent chaos and lack of resources to manage both incidents simultaneously were described in detail by the authors of the reports. |
| Roman-Morales  | Mexico | 2015 | Case report | 0/71 | A gas explosion in a hospital in Mexico City, Mexico is described by Román-Morales (115). The incident injured 71 persons including 27 neonates. The explosion caused fire, discharge of infectious materials and radiation from equipment. For communication, breakdown was seen as the result of a pre-incident setup that included two separate emergency communication systems. |
| Sollid (2011) | Norway | 2011 | Case report | 68/61 | The 2011 Utøya, Norway, lone terrorist attacks, killing 76 people and injuring 159. The main communication issues were breakdown due to system overload, inter-authority communication system incompatibility and lacking MI communication guidelines. The perpetrator's use of a secondary incident site and the subsequent chaos and lack of resources to manage both incidents simultaneously were described in detail by the authors of the reports. |
| Sollid et a. (2012) | Norway | 2011 | Case report | 76/159 | The 2011 Oslo/Utøya, Norway, lone terrorist attacks, killing 76 people and injuring 159. The main communication issues were breakdown due to system overload, inter-authority communication system incompatibility and lacking MI communication guidelines. The perpetrator's use of a secondary incident site and the subsequent chaos and lack of resources to manage both incidents simultaneously were described in detail by the authors of the reports. |
| Yamamura et al. | Japan | 2011 | Questionnaire | 19 747/ 6 242 | the results of a questionnaire on the repercussions of the 2011 Earthquake in Sendai, Japan, killing 19 747 and injuring 6 242, echoing the importance of reliable communication in MI management in an uncompensated disaster. The 9.1 Richter scale underwater earthquake caused an up to 40 meters tsunami. |