



WISCONSIN DEPARTMENT
of HEALTH SERVICES



After the Flood: Comparing Health Impacts Across Two Major Wisconsin Flood Events

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Executive summary

Climate change is causing Wisconsin to become warmer and wetter. Warmer temperatures are intensifying rainfall, increasing runoff, and raising flood risks in areas that are not typically expected to flood. A warming atmosphere holds more moisture which leads to more severe downpours and slower-moving storms causing more significant rainfall. On August 9–10, 2025, severe flash floods impacted Milwaukee and its surrounding areas. According to the National Weather Service, the floods were the result of an unusual weather system that dropped 5–10 inches of record-setting rain in the area, making this event the new state record for rainfall in a 24-hour period. Emergency department (ED) visits related to flooding occurred during the active flooding period from August 9–10, and the recovery period from August 11–September 9. There were 229 hospital ED visits in the Milwaukee area with injuries and illness related to the Milwaukee area flooding that occurred between August 9–September 9, 2025. These visits specifically mentioned flooding as part of their reason for the visit. The number of ED visits spiked on the second day of active flooding and was highest in the days following during the recovery period, leveling off by August 16 with consistent ED visits after that date.

Near real-time ED data was pulled for ED visits related to the flooding. Results indicated that 22% of ED visits occurred during the active flooding days and 78% occurred during the recovery period. Injury-related ED visits were more common than illness-related visits. Of injury-related visits, the most common type of visit was for injuries to the back, extremity, and head. Respiratory illnesses were highest among illness-related ED visits that mentioned flooding. The average age of patients who visited the ED with a flood-related illness or injury was 50.

A similar flooding event occurred in August 2018 across the southern part of Wisconsin. This event had similar types of ED visits but distributed differently. A comparison between the two events highlights the potential needs for different communication strategies, preparedness activities, and potential mental health impacts.

Preventing the health impacts from significant rainfall events like the August 2025 flooding in Milwaukee does not have a single solution; instead, it requires addressing multi-level systems including gray infrastructure, green infrastructure, policy, and public health preparedness. Prevention also includes smart land use, community planning and long-term risk reduction with climate-resilient infrastructure, restoring flood buffers like wetlands and rain gardens, and promoting community awareness during events such as Severe Weather Awareness Week.

Background

As climate change continues to create warm and wet conditions, flooding is expected to increase.¹ Large scale events, like the nationwide flooding experienced in 2022 and 2023, and events once considered rare are now becoming more common¹. In the last decade, nearly every region of Wisconsin has experienced extreme rainfall events that led to flooding of roads, homes, and businesses.²

How climate change is impacting precipitation

As air warms, it can hold more moisture (about 7% more per 1 degree C of warming)³, which causes intense downpours, leading to rapid river rise, flash flooding, and overwhelmed storm drains. Flash floods are the among the deadliest weather hazards in the United States, surpassing hurricanes and tornadoes in annual weather fatalities.⁴ Climate change does not necessarily increase the number of storms, but it does increase rainfall rates and may favor slower-moving storms or stalling systems.⁵

Flooding trends in Wisconsin

Wisconsin continues to experience repeated localized flooding from spring snowmelt over frozen ground, ice jams restricting water flow⁶, and summer thunderstorms with heavy rainfall in low-lying flat areas or overflowing of rivers

¹ USGCRP, 2023: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. <https://toolkit.climate.gov/NCA5>

² *Wisconsin's Changing Climate: Impacts and Adaptation*. 2021. Wisconsin Initiative on Climate Change Impacts. Nelson Institute for Environmental Studies. UW-Madison and Wisconsin Department of Natural Resources, Madison, WI. Available at: <https://wicci.wisc.edu/2021-assessment-report/>

³ Coumou, D., Rahmstorf, S. A decade of weather extremes. *Nature Clim Change* **2**, 491–496 (2012). <https://doi.org/10.1038/nclimate1452>

⁴ National Oceanic and Atmospheric Administration. (n.d.). *Weather Related Fatality and Injury Statistics*. Weather.gov. <https://www.weather.gov/hazstat>

⁵ Chemke, R., Coumou, D. (2024, April 12). *Human influence on the recent weakening of storm tracks in boreal summer*. *Nature and Atmospheric Science*. <https://www.nature.com/articles/s41612-024-00640-2>

⁶ *Coping With Flooding*. Wisconsin DNR. (2024). Wisconsin.Gov. <https://dnr.wisconsin.gov/emergency/FloodCoping.html>

and lakes.⁷ The following flooding events reflect the increases in extreme precipitation intensity, which are consistent with nationwide climate trends.

- May 2020: Northeastern Wisconsin experienced roads flooded from medium to major streams above the flood stage caused by heavy rains and flash flooding.⁸
- March 2019: Fond du Lac and eastern Wisconsin experienced rapid snow melt and ice jams causing rivers to overflow their banks, which forced evacuations and localized urban flooding in downtown areas.⁹
- August 2018: Multiple heavy rain systems in mid-late August caused flash flooding and high rain totals creating some of the highest single-day rain records in southern Wisconsin.¹⁰
- September 2016: Widespread rain and flooding occurred in central and southwest Wisconsin leading to flooding in many parts of the state. River flooding, road closures, and agricultural and transportation impacts resulted.¹¹

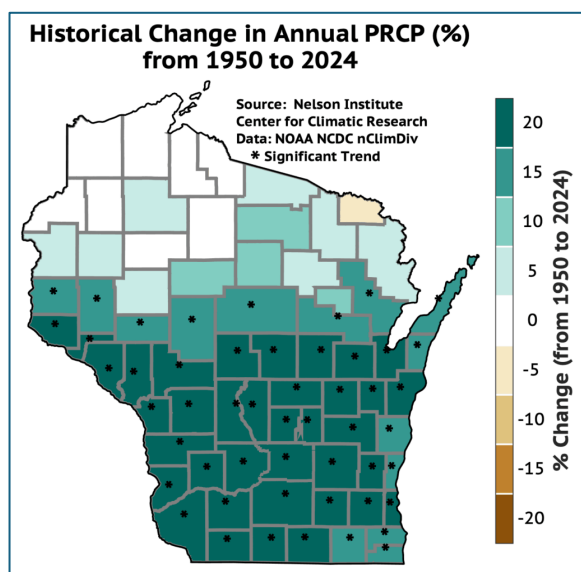


Figure 1: Historical change in annual precipitation from 1950 to 2024

Climate data from the Wisconsin Initiative on Climate Change Impacts (WICCI) Report² shows that the lower two-thirds of Wisconsin counties have had a 20% increase in annual precipitation from 1950 to 2024 on average (Figure 1).

⁷ National Oceanic and Atmospheric Administration, N. (n.d.). *Flooding in Wisconsin*. Weather.Gov. www.weather.gov/safety/flood-states-wi

⁸ FOX 11 Weather. (2020, May 28). *Streets flood as heavy rains fall in Northeast Wisconsin*. WLUK. <https://fox11online.com/weather/weather-stories/waters-rise-as-heavy-rains-fall-in-northeast-wisconsin>

⁹ FOX 11 News. (2019, March 14). *Ice dam on Fond du Lac River leads to flooding, evacuations*. WLUK. <https://fox11online.com/news/local/water-rescues-going-on-right-now-in-fdl>

¹⁰ National Oceanic and Atmospheric Administration. (n.d.). *Last Week's Flooding and Severe Weather (Aug 17-27)*. Weather.Gov. <https://www.weather.gov/mkx/August2018SevereandFlood>

¹¹ National Oceanic and Atmospheric Administration. (2016). *September 21-22, 2016 Flooding*. Weather.Gov. <https://www.weather.gov/mkx/September21Flooding>

Looking into the future, WICCI predictions show that with no change in greenhouse gas emissions, Wisconsinites can expect many more days each year with more than 1 inch of rain (Figure 2)².

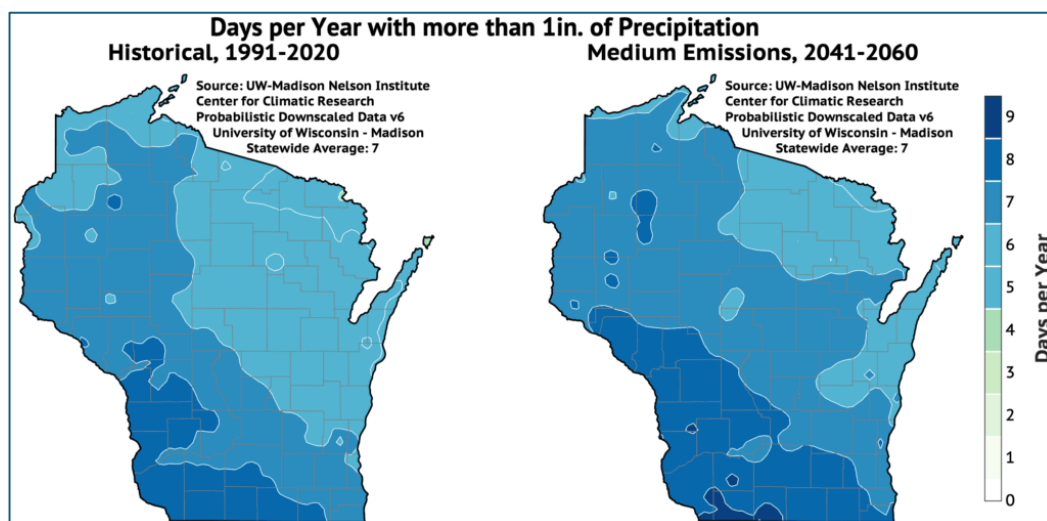


Figure 2: Days per year with more than one inch of precipitation

Annual flooding of this magnitude causes significant damage to property and infrastructure¹², negatively impacts the state's economy¹³, and poses significant risks to human life and safety.¹⁴ Large-scale rain events pose health and safety risks, particularly for susceptible populations such as older adults, young children, socially isolated people, unhoused people, those with low economic status, and people living in unsafe housing.¹⁵ Lower-income communities are more often located in flood-prone areas, such as low-lying areas, near rivers, or older infrastructure.¹⁶ Housing in these areas may be less resilient to flooding due to aging structures, poor drainage, and maintenance. With limited financial resources, low-income populations face more economic barriers to preparation, evacuation, and recovery. Older adults, children, and people with disabilities may

¹² WICCI Infrastructure Working Group. *Wisconsin Initiative on Climate Change Impacts (WICCI)*. Wisconsin Initiative on Climate Change Impacts. <https://wicci.wisc.edu/infrastructure-working-group/>

¹³ NOAA National Centers for Environmental Information (NCEI) *U.S. Billion-Dollar Weather and Climate Disasters* (2025). <https://www.ncei.noaa.gov/access/billions/>, DOI: [10.25921/stkw-7w73](https://doi.org/10.25921/stkw-7w73)

¹⁴ CDC. (2024, February 23). *Floods and Your Safety*. Floods. <https://www.cdc.gov/floods/about/index.html>

¹⁵ Lowe D, Ebi KL, Forsberg B. *Factors increasing vulnerability to health effects before, during and after floods*. Int J Environ Res Public Health. 2013 Dec 11;10(12):7015-67. doi: [10.3390/ijerph10127015](https://doi.org/10.3390/ijerph10127015). PMID: 24336027; PMCID: PMC3881153.

¹⁶ *Economically Disadvantaged Communities* | USDA Climate Hubs. (n.d.). [www.Climatehubs.Usda.Gov. https://www.climatehubs.usda.gov/hubs/northwest/topic/economically-disadvantaged-communities](https://www.climatehubs.usda.gov/hubs/northwest/topic/economically-disadvantaged-communities)

have difficulty with evacuation, health care access, and chronic condition exacerbation due to stress, disrupted care, and mold. Communities with fewer infrastructure investments such as stormwater systems and levees face greater impacts from flooding. Addressing flooding vulnerability requires targeted outreach, accessible communication, and equitable preparedness planning and response efforts.

During and immediately after a severe flooding event, the health risks include drowning, blunt force trauma, injury from damaged and unsafe property, exposure to mold, and exposure to contaminated water. After a flood event, consumption of contaminated food and drinking water, contact with contaminated water, electrocution, and injury during clean-up are additional health risks individuals may face.

Because of these health risks, the Wisconsin Climate and Health Program, Office of Health Informatics, and the Office of Preparedness and Emergency Health Care at the Wisconsin Department of Health Services, began tracking health impacts of the southeast Wisconsin 2025 flood using syndromic surveillance from the National Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE) and emergency medical services (EMS) data in near real-time.

August 2025 flooding surveillance

The August 2025 flooding in southeast Wisconsin was one of the most extreme rainfall events in state history, dropping 5-10 inches of rain over southeast Wisconsin in a short time. This “1000-year rainfall” deposited more than 12 inches of rain in 24-hours in some rain gauges, a new Wisconsin daily rainfall record. Rivers such as the Milwaukee, Menomonee, and Root Rivers reached record to near-record flood stages. A state of emergency was declared on August 10 after reports of several water rescues, flooded homes, roads, and power outages. As of January 6, 2026, residents in Milwaukee, Waukesha, and Washington counties received more than \$195 million in Federal Emergency Management Agency (FEMA) assistance¹⁷.

¹⁷ Heim, M., Looby, C. (2026, January 8). *Milwaukee-area flood was FEMA's second-most expensive 2025 disaster*. Milwaukee Journal Sentinel.

Methods

Flood-related ED visits were identified using data from the ESSENCE, which gathers data from participating hospital EDs across the country. ESSENCE is a near-real-time surveillance system, capturing data from approximately 94% of the state's EDs. "Flooding-related" complaints are defined as daily ED visits that mentioned "flood" and had primary complaints of: "mold exposure", "fall during clean up", "injury during clean up", or "illness during clean up" (including word derivatives and misspellings). Terms that have been identified in the search such as "carbon monoxide exposure", are included in the total ED visits if visit specified it was related to the flooding. Due to the nature of categorizing ED complaint data, these visits do not represent all potential cases of flood-related illness or injury. This data may also represent non-flood-related illnesses (for example, weakness due to other causes). However, the data can be used to describe trends in illness presentations over time.

Flood-related complaints were categorized into one of three syndromes based on the chief complaint:

- Injury-related ED visit: falls, injuries, electrical shock, motor vehicle accident, and lacerations
- Illness-related ED visit: respiratory, medication issues, bug bites, mental health, poisoning, gastrointestinal (GI), and chest pain
- Additional complaints: skin rash, carbon monoxide, and weakness

Results

During the active flooding days of August 9 and 10, 77% of the flood-related ED visits were for injuries and pain from initial clean-up efforts. ED visits for medication or oxygen needs, carbon monoxide poisoning, electrical shock, and other reasons (examples of "other" reasons for visit are eye issues, diarrhea, or infection) were 33% of the flood-related ED visits on those two days. After the first day of the recovery period of August 11–27, there was a decrease in visits for carbon monoxide or electrical shock, but continued visits for respiratory illnesses, and injuries/pain from flood clean-up activities (Figure 3).

<https://www.jsonline.com/story/news/environment/2026/01/08/milwaukee-area-flood-was-femas-second-most-expensive-2025-disaster/87962767007/>

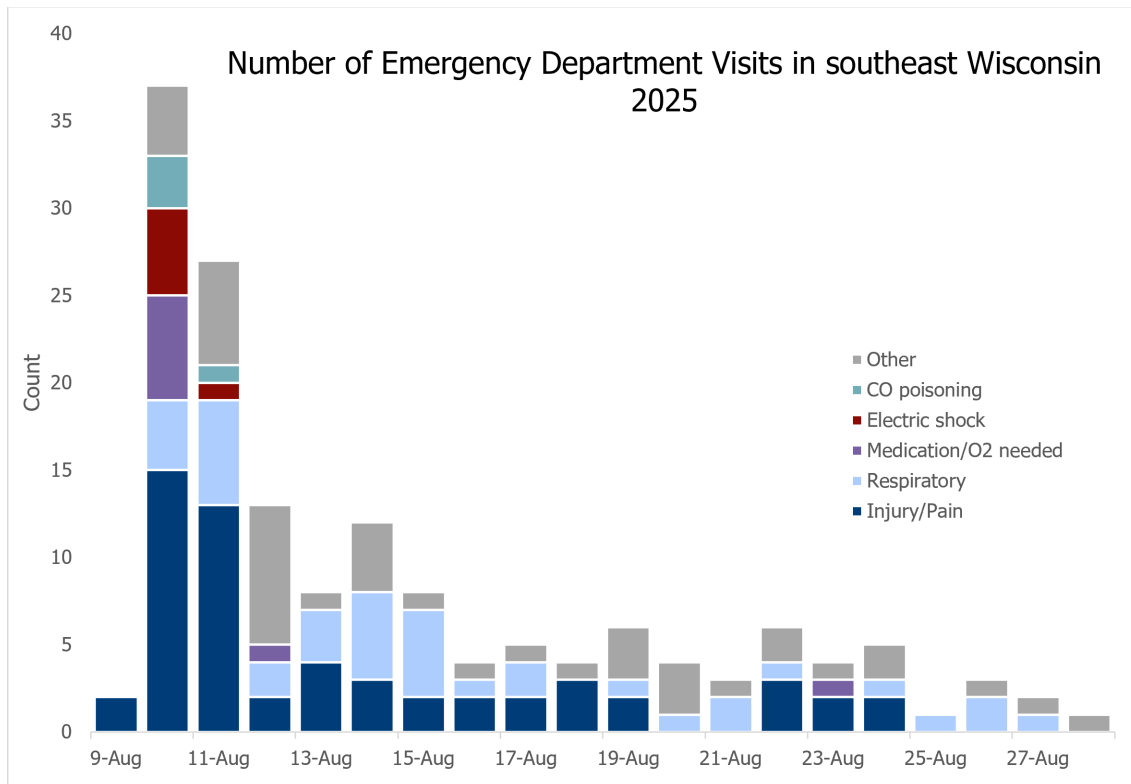


Figure 4: Number and type of ED visits during active flooding (August 9–10) and short-term recovery (August 11–September 9, 2025) in the Milwaukee area

There were a total of 229 flood-related ED visits during the monitored period

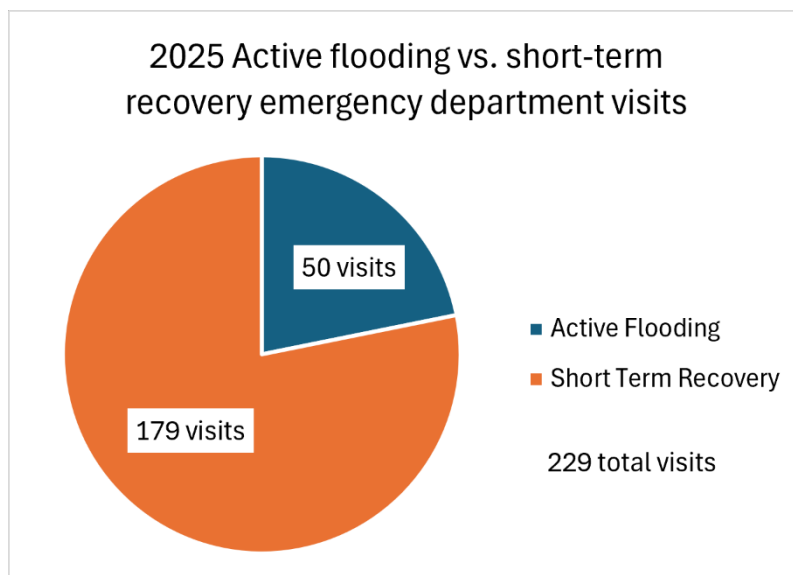


Figure 3: Total ED visits during the Milwaukee area flooding (August 9–August 28, 2025) during active flooding (50 visits) and short-term recovery (179 visits)

(August 9–28) as identified through triage notes. Active flooding accounted for 22% of all ED flood-related visits (50 visits) whereas the 30-day recovery period accounted for 78% of ED flood-related visits (179 visits) (78%) (Figure 4).

Visits peaked in the first three days of the monitoring period (August 9–11) and continued to taper lower throughout the period (Figure 5).

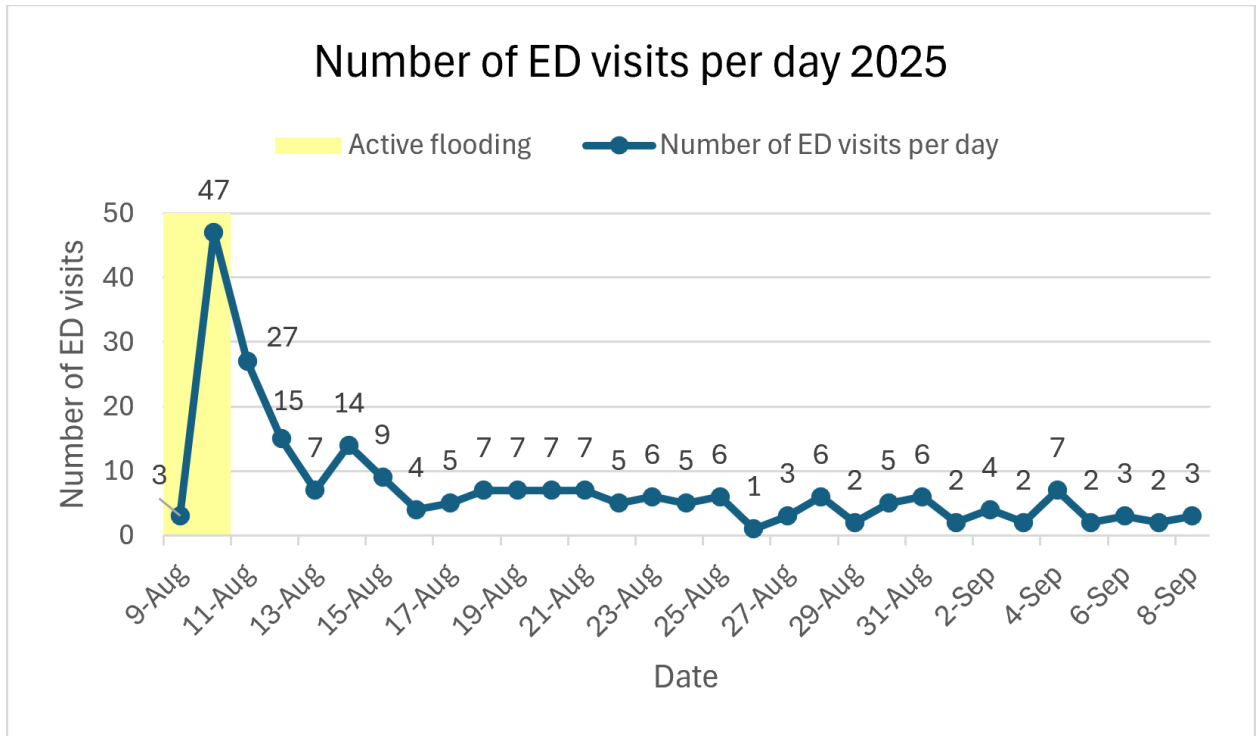


Figure 5: Number of ED visits per day during active flooding (August 9–10) and recovery (August 11–September 9)

The highest number of flood and illness-related ED visits during the flooding event were respiratory related illnesses (48%), including asthma, mold-induced respiratory illness, and difficulty breathing. Mental health related issues accounted for 10% of the ED visits specifically related to flooding. There were equal number

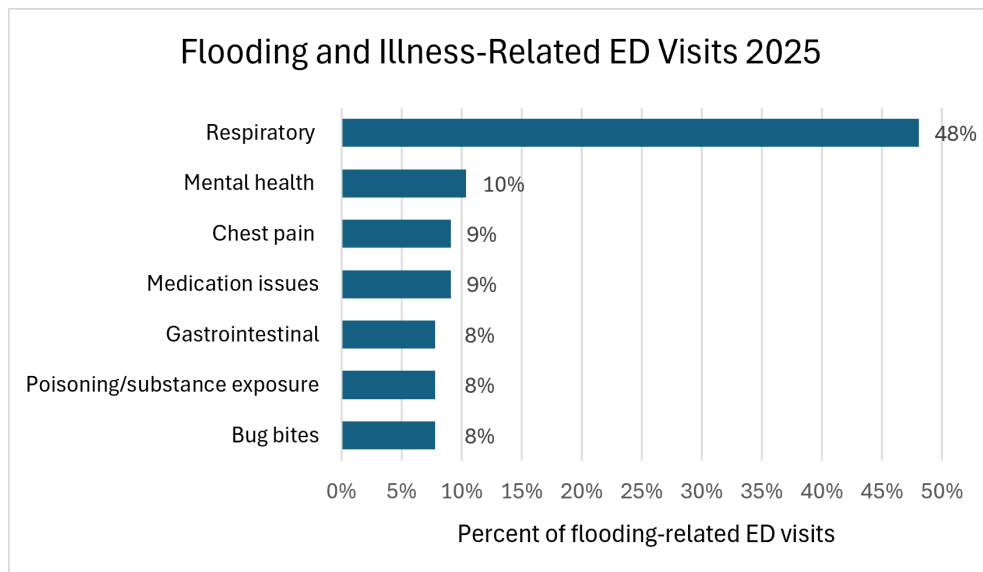


Figure 6: Flooding and illness-related emergency department visits during Milwaukee area flooding (August 9–September 9, 2025)

of ED visits for chest pain and medication issues (9%) and for gastrointestinal, poisoning, and bug bites (8%) (Figure 6).

The highest number of flooding and injury-related ED visits were bodily injuries related to flooding or flooding clean-up activities (57%) (Figure 7). The second highest number of injury-related ED visits were falls (22%), followed by electrical shock (10%), lacerations (8%), and the least amount were motor-vehicle accidents (3%).

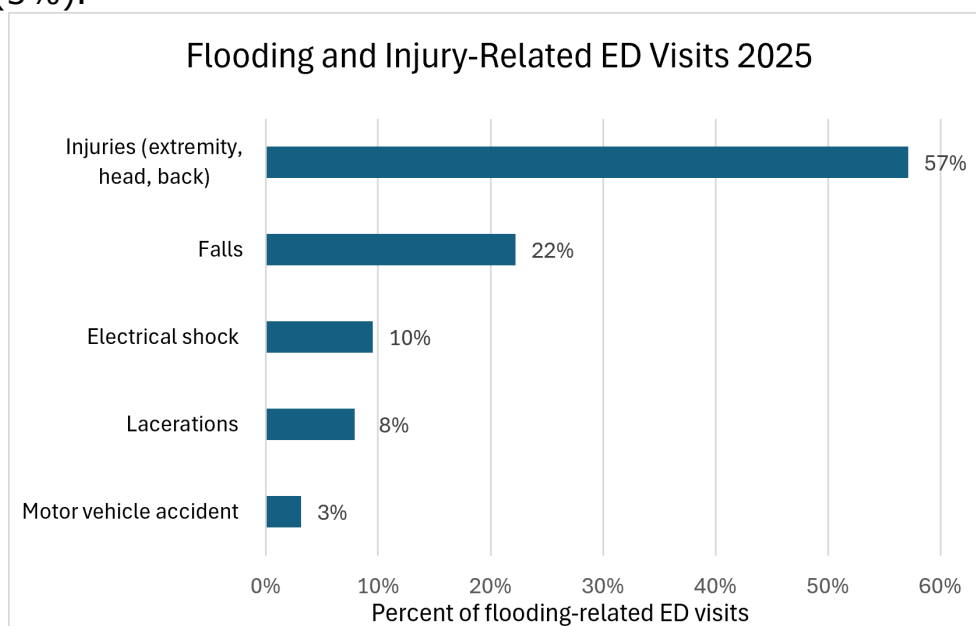
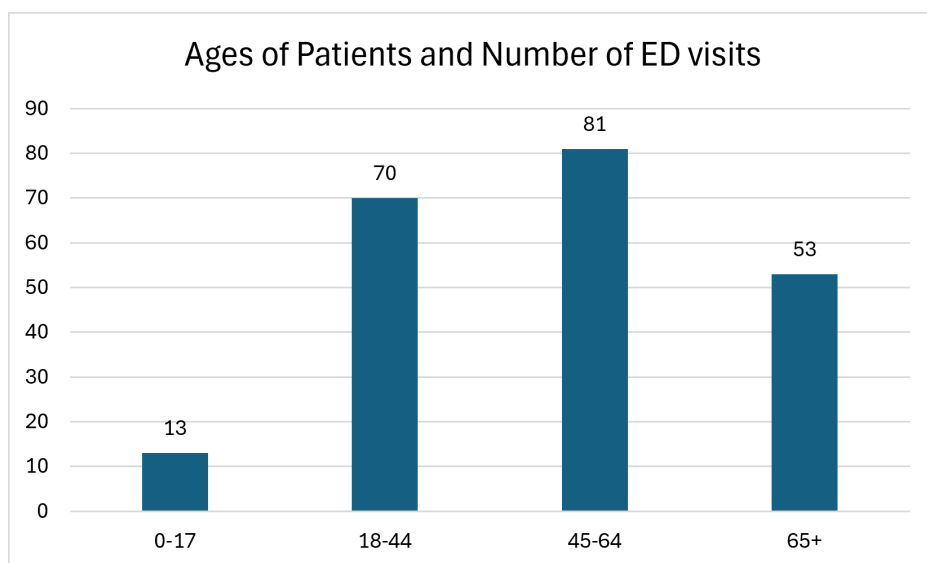


Figure 7: Flooding and injury-specific ED visits during Milwaukee area flooding (August 9–September 9, 2025)



The highest number of ED visits during the flooding event occurred among patients aged 45–64, followed by patients aged 18–44, and then aged 65+. Children aged 0–17 were the group with the least number of ED visits during the flooding event (Figure 8).

Figure 8: Age of patients for ED visits related to flooding (August 9–September 9, 2025)

Comparison: 2018 southern Wisconsin flooding

A similar review of near real-time ED visits was conducted during flooding in Wisconsin from August 17–September 20, 2018. Storm-related ED visits were identified using data from ESSENCE which had 84% reporting coverage at that time. “Storm-related” complaints were defined as daily ED visits that mentioned “flood”, “wind”, or “rain” and had primary complaints of: “illness”, “injury/trauma”, or “behavioral/mental health issues”. Counties affected by this series of storms spanned the southern part of the state with the western counties hit hardest: Adams, Calumet, Columbia, Crawford, Dane, Dodge, Fond du Lac, Green Lake, Iron, Jefferson, Juneau, La Crosse, Lincoln, Marquette, Monroe, Ozaukee, Richland, Sauk, Sheboygan, Vernon, and Washington. Estimated damages from this event totaled approximately \$232 million. During this event, 58 ED visits were identified as being directly related to storms and flooding. Of these events, 27 were injury-related and 31 illness-related.

During the 2018 southeastern Wisconsin flood event, there were significantly more flood-related ED visits during short-term recovery relative to the visits during active flooding; seven visits occurred in the 12 days of active flooding versus 51 visits during the 20-day recovery period, which is an average of one to two visits

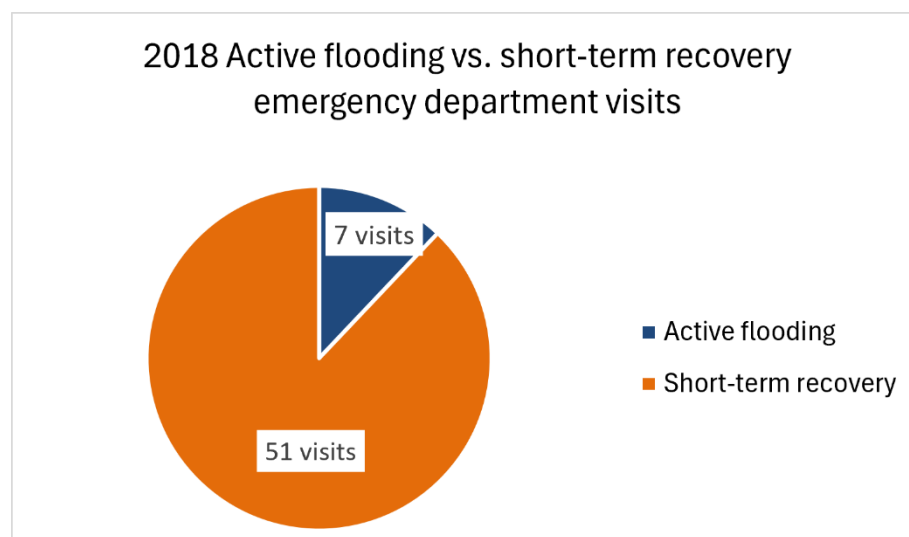


Figure 9: Total ED visits during the 2018 southern Wisconsin flooding (August 17–September 20, 2018) during active flooding (seven visits) and short-term recovery (51 visits)

per day (Figure 9). During the total monitoring period, a total of 58 visits were identified as being specifically related to the flooding event through triage notes.

The highest number of ED visits were seen days after the active flooding stopped on September 6. During the active flooding period of 2018, there were six ED visits specifically related to the flooding (Figure 10).

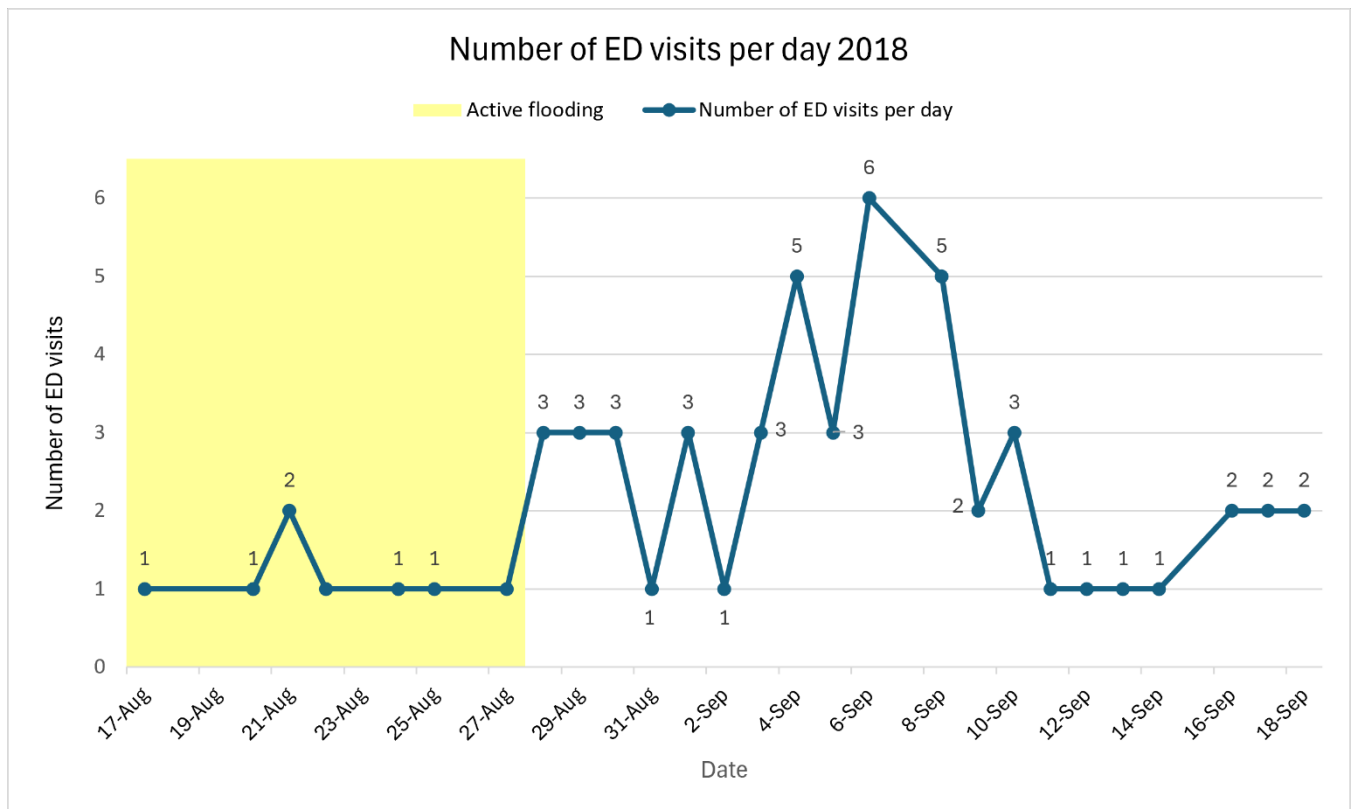


Figure 10: Number of ED visits per day during active flooding (August 17–27) and recovery (August 28–September 18)

During the 2018 southeastern flood and recovery time frame, wounds were the highest ED visit reason related to flooding and illnesses at 32%. Vehicle crash

injuries and falls were also reported as a common reason for ED visits at 23% (Figure 11).

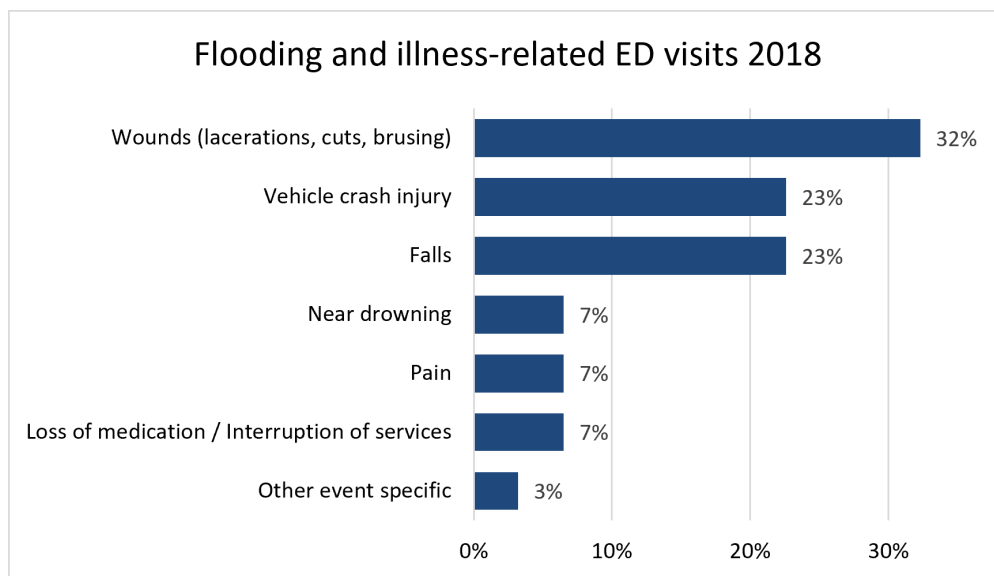


Figure 11: Flooding and Illness-related ED visits during southern Wisconsin flooding (August 17–September 20, 2018)

Dermatological and mental and behavioral ED visits related to the 2018 flooding were 30% each. Respiratory and flood-related visits accounted for 22% of the ED visits specifically related to flooding (Figure 12).

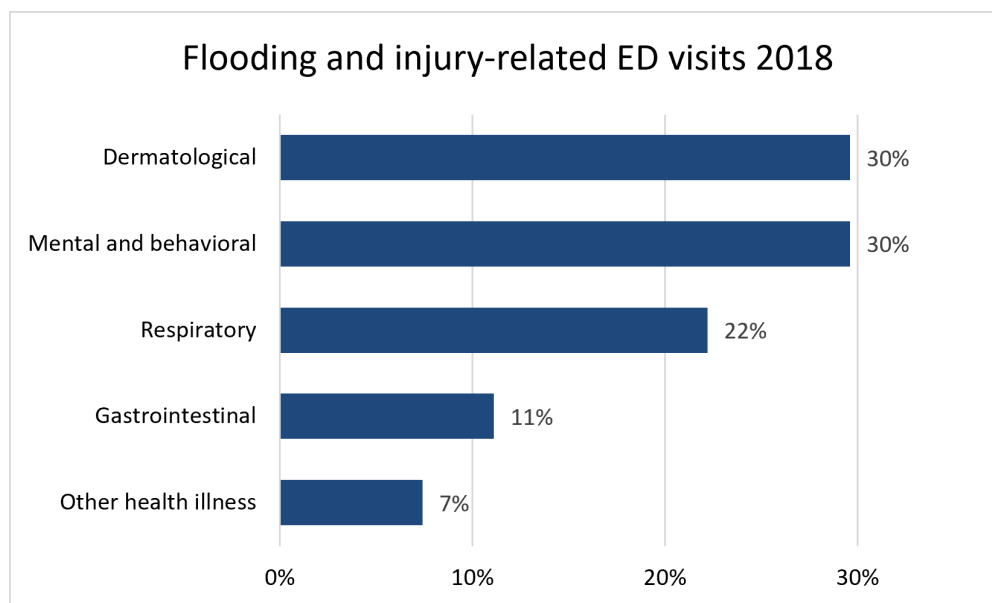


Figure 12: Flooding and injury-related ED visits during southern Wisconsin flooding (August 17–September 20, 2018)

Discussion

Differences between 2018 and 2025 flooding events

The 2018 and 2025 flooding events were identified using different ESSENCE query definitions due to differences in case definition and ESSENCE coding, which limits the comparability of findings between them. Because query construction (for example, differences in chief complaint and discharge diagnosis (CCDD categories, free-text terms, or case definitions used) directly shapes which visits are captured, differences in visit counts or patterns between 2018 and 2025 may reflect variation in query sensitivity rather than a true difference in flood-related health impact. Any comparison between the two events should be interpreted as illustrative rather than a precise trend comparison.

The first difference we noticed between the two events was the timing of ED visits. In 2025, the majority of visits occurred during active flooding and in the days immediately following. In 2018, the majority of ED visits occurred in the week following the flood during the later recovery period.

The second difference between the two events was the types of visits reporting to EDs. Both events had injury and illness-related visits; however, the most prevalent injuries differed. In 2018, wound-related ED visits (injuries from yard cleanup) were the most prevalent whereas in 2025 bodily injuries (strain or blunt force trauma related to home clean-up) were the most prevalent.

Regarding illness-related ED visits, the 2018 flood experienced a high number of mental health and dermatological visits, whereas the 2025 flood had a high number of respiratory visits.

Lastly, in 2018, there were a high number of motor-vehicle crash injuries compared to 2025. After discussions with the Wisconsin Ambulance Run Data System staff about EMS data, it was learned that in 2025 there were a significant number of water rescues during the flood that was not reflected in ESSENCE data.

Similarities between 2018 and 2025 flooding

The types of visits, both injury- and illness-related, during both events were quite similar if distributed differently. Illness-related visits for respiratory and gastrointestinal illness were both high in 2018 and 2025, and both floods had

similar number of visits due to loss of medication or interruption of services and visits pertaining to unspecified pain.

Limitations

- ESSENCE data tracks suspected symptoms and chief complaints rather than lab-confirmed diagnoses, and ED chief complaints can have misspellings, abbreviations, or might not include the context of flooding. This would result in an undercounting of the true number of flood-related ED visits.
- Utilizing near-real time data to track ED visits related to flooding is not straightforward as there is no case definition for flood-related illness or injury.

Takeaways

Post-flood event clean-up communication is imperative to keeping people healthy. In a community experiencing flooding, knowing the population's clean-up needs is important. Communities may need to highlight either basement clean-up safety and/or outdoor clean-up hazards based on location and community needs.

Communities need to be prepared for local flood hazards. It is important to be aware of the types of flooding the community may be at risk from (for example, flash flooding due to impervious surface vs. riverine flooding). Have conversations with the community about flood risks specific to the community's needs. This may inform clean-up communications and the possible types of injuries to be expected in an ED.

Consider the mental health impacts of flooding. In 2018, the active flooding period was longer than the 2025 active flooding period. Therefore, the 2018 flooding may have interrupted mental health services for longer than the 2025 flooding. Riverine versus flash flooding could change the way people seek care. Parts of the state affected by the 2018 flood may experience flooding more regularly, causing individuals to seek mental health support due to repeated flooding, whereas during the 2025 flood this may have been the first flood of this level of severity experienced by people.

As of the writing of this report, people are still displaced from their homes from the 2025 flood. If the authors were able to review continued mental health impacts due to the 2025 flood, it's suspect there would be a higher number of mental health needs.

Services from both state and federal partners can make the difference. In 2018, a federal disaster declaration was issued to provide individual and public assistance.¹⁸ The 2015 flooding did not receive a federal disaster declaration, limiting the resources and assistance for recovery. This likely resulted in compounding health impacts.

Conclusion: Preventing illness and injury from flooding

Flooding can create immediate and long-term public health risks. Local public health plays a critical role in flooding prevention, communication, and recovery. Preparedness should be a multi-disciplinary coordinated approach to include the most vulnerable populations and protect critical infrastructure, including facilities that are essential to a community's health and safety such as healthcare facilities and wastewater treatment plants. Effective public health communication should be timely and actionable, clear and easy to understand, available in multiple languages and formats, and shared through trusted community partners and local media. Public health guidance should focus on injury and illness prevention, which includes communicating ways to reduce common flood-related injuries, preventing foodborne and waterborne illnesses, and safe cleanup practices. It is important for public health to monitor and address health impacts by conducting surveillance to identify disparities, prioritize outreach efforts, and protect at-risk populations. As flooding events become more frequent and severe, public health serves an important role in preparing for and responding to such events, reducing illness and injury, and addressing health inequities.

Flood defense infrastructure can help to mitigate the risks of heavy rainfall, but reducing greenhouse gas emissions is the best way to stabilize both the climate and water cycle. Local public health can support long-term resilience through both flood defense (gray and green infrastructure investments, updated floodplain zoning, building codes, and early warning systems) and emissions reduction as complementary strategies, not substitutes. This will ensure that Wisconsin communities, particularly those with the fewest resources to adapt, are protected today while addressing the underlying driver of tomorrow's flood risk.

¹⁸ FEMA, (2018, November 2). *Wisconsin; Major Disaster and Related Determinations*. Federal Register. <https://www.federalregister.gov/documents/2018/11/02/2018-23919/wisconsin-major-disaster-and-related-determinations>