

# Electricity generators used indoors: a source of carbon monoxide poisoning



© 123RF

## CARBON MONOXIDE, A SILENT KILLER

Carbon monoxide, which has the chemical formula CO, is responsible for around a hundred deaths and 1300 poisonings in France every year [1]. Odourless, colourless and non-irritating, it can lead to coma and death sometimes within just a few minutes. It is therefore vital to spot the symptoms of poisoning as quickly as possible: headaches, tiredness, nausea and dizziness, which can affect several people in the same place at the same time. Depending on its severity, poisoning may require hospitalisation and sometimes leaves sequelae such as neurological disorders and cardiac problems.

In addition to immediate treatment by firefighters or mobile emergency services, French poison control centres (PCCs) are closely involved in the treatment of this type of poisoning. Contacted by the medical services or individuals themselves, they carry out individual medical investigations, searching for the cause of the poisoning and monitoring its progression. Moreover, by entering this information into the PCCs' national database, they help improve knowledge of this type of accident.

## POISONING DUE TO GENERATORS FOLLOWING THE STORMS OF WESTERN FRANCE IN NOVEMBER 2023

Carbon monoxide is mainly produced when combustion appliances (such as water heaters, boilers or wood-burning stoves) malfunction. However, it can also be emitted by appliances used due to exceptional weather conditions such as storms: generators during power cuts, motor-driven pumps in the event of flooding, braziers during heating cuts, etc. The toxic exhaust gases emitted by these appliances include carbon monoxide.

Carbon monoxide continues to be responsible for around 1300 cases of poisoning a year in France. It is mainly emitted when combustion appliances malfunction, but also when they are used inappropriately. Between 1 and 8 November 2023, the power cuts caused by storms Ciarán and Domingos led to a need for auxiliary heaters. The inappropriate use of generators or the escape of combustion gases from boilers caused 91 people to be exposed to carbon monoxide. Symptoms occurred in three-quarters of cases: 69% were mild and 24% were of medium severity. Serious poisoning caused life-threatening symptoms in four people and one death. When generators are needed, such as during exceptionally bad weather conditions, they must never be operated inside homes.

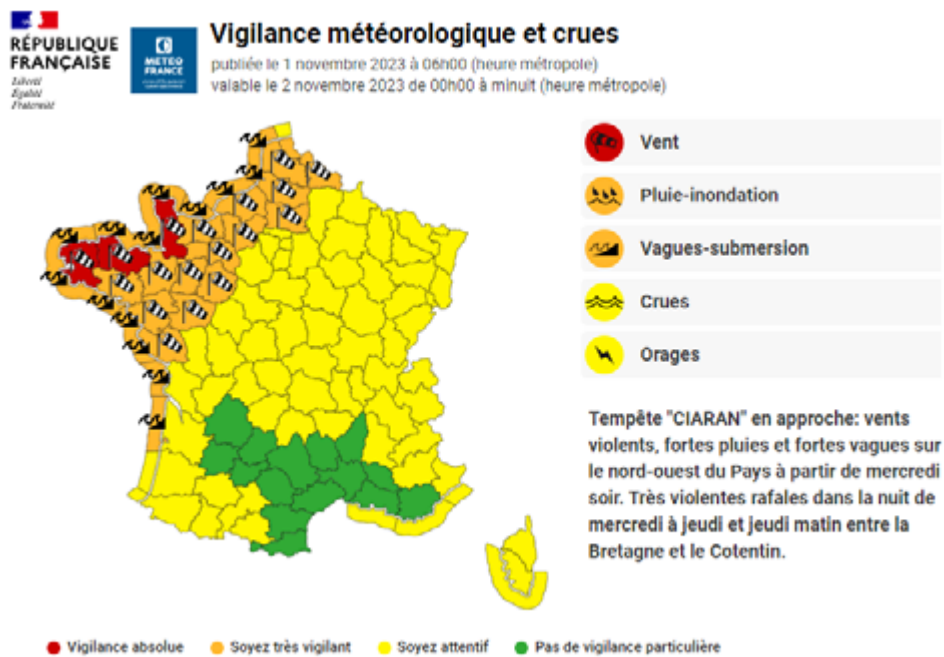
When mistakenly used inside homes, cellars, garages or attics, they can cause poisoning.

Between 1 and 6 November 2023, severe weather warnings were issued for the départements of Finistère, Côtes d'Armor and Manche, rising to «red» on 2 November 2023,

in anticipation of storm Ciarán (see Figure 1). An «orange» alert was then issued for Domingos, a less violent storm than Ciarán, in the Vendée département between 3 and 5 November 2023 [2]. Between 1 and 8 November 2023, these storms caused lengthy power cuts for many households [3].

**Figure 1 – Map of France showing weather forecasts for the passage of storm Ciarán**

(Source Météo France)



An analysis of calls to poison control centres during the storms and in the days that followed, i.e. from 1 to 25 November 2023, confirmed that these two exceptional climatic events were responsible for an increase in carbon monoxide poisoning.

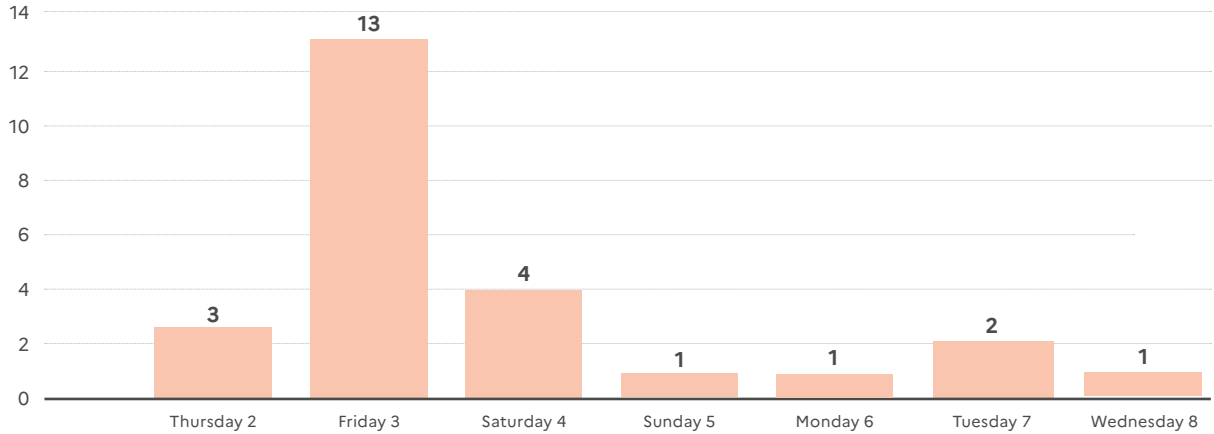
For this analysis, the events of interest corresponded to a place where one or more people had been accidentally exposed to carbon monoxide during the storm period.

Excluding all other circumstances that could have been responsible for poisoning (e.g. fires, intentional poisoning, boiler malfunctions unrelated to the storms), 25 events occurring between 2 and 8 November 2023 and directly due to the weather conditions were identified. After this date, the events no longer had any link with the severe weather alert issued for storm Ciarán. More than half of the events (52%; 13 out of 25) were reported

24 hours after the storm, i.e. on 3 November (see Figure 2), then there were between one and four events per day until 8 November.

**Figure 2 – Number of carbon monoxide exposure events during storms Ciarán and Domingos in November 2023**

(Source SICAP)

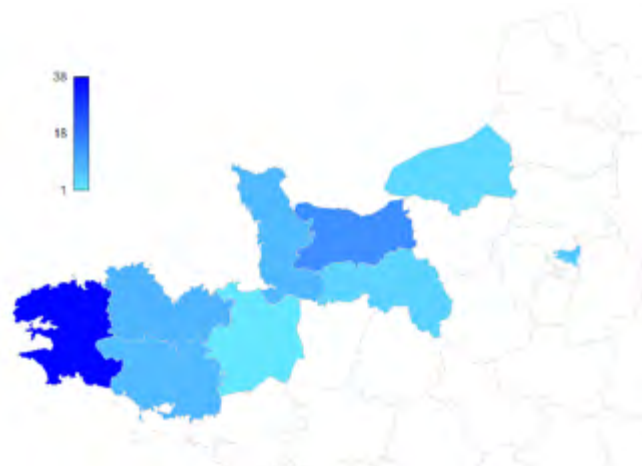


The most affected regions and départements corresponded to the areas through which the storms passed, i.e. mainly Finistère in Brittany (36%; 9 events out of 25) and Calvados in Normandy (16%; 4 out of 25) (see Figure 3). One event occurred in Ile-de-France on 4 November 2023:

the environmental investigation concluded that combustion gases from a boiler had escaped due to a faulty flue and the extremely windy weather conditions that day. The strong winds at the time of the accident had caused an inversion of the draught in the flue to which the boiler was connected.

**Figure 3 – Breakdown of cases of exposure to carbon monoxide, by département for the north-west regions and Ile-de-France**

(Source SICAP)



Dans plus de 90 % des évènements rapportés (23 sur 25), use of a generator was the cause of the carbon monoxide poisoning. With the exception of one event for which the location was not specified, the generators had always been placed inside or very close to a dwelling: in a garage (52%; 12 out of 23), in a cellar (30%; 7 out of 23), in a home with no further details (9%; 2 out of 3), in a kitchen (1 out of 23).

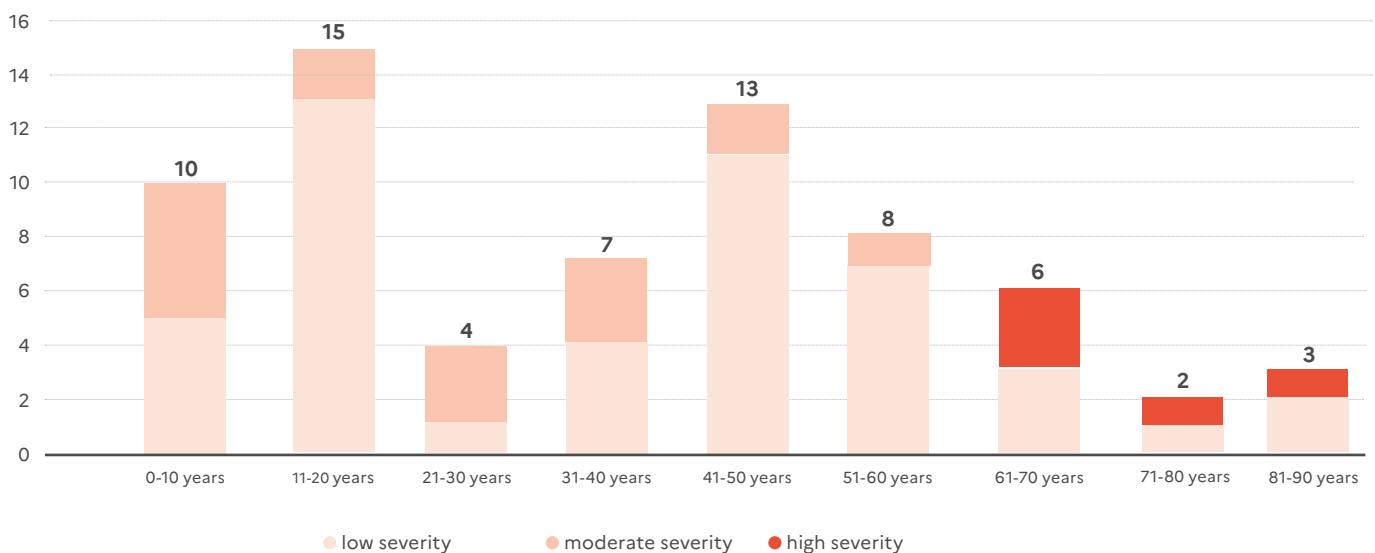
combustion gases from a boiler, another event was due to obstruction of a house's chimney flue by birds' nests, which had fallen due to the storm.

These 25 events had exposed 91 people to carbon monoxide, from one to seven people per event, most often members of the same family. They ranged in age from 7 months to 87 years, and 40% (36 out of 90) were children and adolescents (see Figure 4).

Besides the event described above due to the escape of

**Figure 4 – Breakdown by age group and severity of the number of people exposed to carbon monoxide during storms Ciarán and Domingos**

(Source SICAP)



People experienced symptoms following the exposure to carbon monoxide in three-quarters of the cases (68 out of 91). Among these 68 poisoning cases:

- Four poisoning cases were very serious: these patients were all over 60 years of age (61 to 85 years) and had been found comatose in their homes. In all four cases, the generator had been placed in a cellar or garage. Three out of four patients received hyperbaric oxygen therapy.

- 69% (47 out of 68) were mild. People suffered from headaches, nausea, asthenia, discomfort and dizziness, which are all signs of carbon monoxide poisoning. Six of them required hyperbaric oxygen therapy (in a hyperbaric chamber).

- One person, who had installed a generator in the garage, died of cardiac arrest despite medical treatment.

- 24% (16 out of 68) were of moderate severity. People suffered from discomfort and brief loss of consciousness, which in 81% of cases (13 out of 16) was treated with hyperbaric oxygen therapy.

**OTHER PARTS OF THE WORLD ALREADY FAMILIAR WITH THIS HIGH-RISK EXPOSURE**

Although exceptional climatic events such as storms are not rare in France, their number and strength could increase in the future, reaching levels already seen in many other countries. In these countries, specific warnings about the risks of

carbon monoxide poisoning in the event of bad weather are circulated widely several days before the event, to reduce the risk.

In Canada, power cuts due to bad weather are common and can last for a long time. In 1998, a cold spell that left thousands of people without electricity for 30 days led to an increase in the number of cases of carbon monoxide poisoning. After two weeks of power cuts, this number was equivalent to that observed for the whole of 1997. Six people died and 51 had to be treated with hyperbaric oxygen therapy. The National Institute of Public Health of Quebec recommended that generator manufacturers affix labels to their products warning of the risks of carbon monoxide poisoning, because many

consumers were unaware that combustion engines are a source of carbon monoxide emissions [4].

Health Canada has also warned of the risk of carbon monoxide poisoning if a generator is placed outdoors but too close to a dwelling. It recommends placing it at least 6 metres from any door, window or air vent to prevent carbon monoxide from entering the house [5]. Health Canada also recommends the purchase of generators fitted with a carbon monoxide sensor that triggers an automatic shut-off if an emission threshold is exceeded (see Figure 5).

In the United States, users are also recommended to always place the generator 6 metres away from their house and to purchase a generator fitted with a carbon monoxide sensor and a safety shut-off system (see Figure 6) [6].

**Figure 5 – Safety tip of the week: Carbon monoxide**

(Source Health Canada)



CONSUMER PRODUCTS SAFETY TIP OF THE WEEK In the event of a power cut this winter, never use barbecues or portable fuel-burning generators inside your house or garage, as they can produce lethal carbon monoxide gas. When buying a portable generator, opt for one fitted with a carbon monoxide sensor and automatic shut-off. Reminder: check your smoke and carbon monoxide detectors once a month and replace the batteries as needed!

**Figure 6 – Carbon Monoxide (CO) The Invisible Killer**

(Source Consumer Product Safety Commission)





In April 2023, the US Consumer Product Safety Commission (CPSC) resubmitted a proposed rule to require the sale of generators fitted with a carbon monoxide detector and an automatic shut-off system in the event of excessively high emissions. This proposal, which had been supported by the CPSC for several years, aims to prevent deaths from carbon monoxide poisoning: in the United States, 1300 deaths were recorded between 2004 and 2021, a quarter of which affected entire families as a result of generator misuse [7]. Pending inclusion in the regulatory framework, the CPSC reiterated its warnings to the general public and recommended the purchase of certified generators fitted with this automatic shut-off system, which can reduce deaths by 87% to 100% [8].

## DO'S AND DON'TS DURING EXCEPTIONALLY BAD WEATHER

During a prolonged power or heating cut or in the event of flooding [1-2], it is essential to:

- position generators outside living areas, including cellars, attics, basements and garages, and well away from air intakes;
- place pumps or any other combustion engine-powered appliance outside homes and away from air intakes;
- never use cookers, braziers or barbecues for heating;
- never run auxiliary heaters on a continuous basis.

If you suspect carbon monoxide poisoning, take prompt action:

- ventilate the premises;
- if possible, switch off the generators or any other equipment used;
- evacuate the premises;
- call the emergency services:
  - o 15, 18 or 112 (114 for the hearing impaired),
  - o or +33 (0)1 45 42 59 59 (24/7 emergency number in France) to contact a poison control centre.



**Marie Deguigne (Angers PCC)**  
**Cécilia Solal (ANSES)**

## RÉFÉRENCES BIBLIOGRAPHIQUES

- [1] Directorate General for Health. ANSES. December 2023. Carbon monoxide poisoning can be fatal and concerns everyone: you can reduce the risks by adopting the right practices. Press release. <https://www.anses.fr/en/system/files/Press2023EN-CP18.pdf>
- [2] Vendée state services. 2023. STORM DOMINGOS, ORANGE alert for violent winds, from Saturday 4 November 2023 at 6 pm to Sunday 5 November 2023 at 3 am. <https://www.vendee.gouv.fr/Actualites/Grands-dossiers/Alertes/TEMPETE-DOMINGOS>
- [3] Normandy Regional Health Agency. November 2023. Attention au risque d'intoxication au monoxyde de carbone lié au mauvais usage de certains appareils. [Beware of the risk of carbon monoxide poisoning due to the misuse of certain appliances.] Press release. <https://www.normandie.ars.sante.fr/attention-au-risque-dintoxication-au-monoxyde-de-carbone-lie-au-mauvais-usage-de-certains-appareils>
- [4] National Institute of Public Health of Quebec (INSPQ). 2010. *Les avertisseurs de monoxyde de carbone comme mesure de protection au Québec. État de situation et perspectives d'intervention.* [Carbon monoxide alarms as a protective measure in Quebec. Situation and prospects for action.] [https://www.inspq.qc.ca/sites/default/files/publications/1075\\_avertisseurscomasureprotection.pdf](https://www.inspq.qc.ca/sites/default/files/publications/1075_avertisseurscomasureprotection.pdf)
- [5] Santé Canada. 2024. La sécurité dans votre cour et à l'extérieur. Génératrices portatives à combustible. <https://www.canada.ca/fr/sante-canada/services/securite-maison-et-jardin/securite-votre-cour.html#a5>
- [6] Centers for Disease Control and Prevention. 2024. Carbon Monoxide - Generator Safety Fact Sheet. <https://www.cdc.gov/co/generatorsafetyfactsheet.html>
- [7] Consumer Product Safety Commission. 2023. CPSC's groundbreaking proposed rule for portable generators will save thousands of lives and will save \$1B a year in costs. [https://www.cpsc.gov/s3fs-public/TrumkaportablegeneratorsSNPRstmt4\\_5\\_23.pdf?VersionId=3pxNNcoMz3knrnSSCcx\\_rXPcnXjuN6jW](https://www.cpsc.gov/s3fs-public/TrumkaportablegeneratorsSNPRstmt4_5_23.pdf?VersionId=3pxNNcoMz3knrnSSCcx_rXPcnXjuN6jW)
- [8] Consumer Product Safety Commission. 2024. As Winter Storms Continue, CPSC Urges Families to Take Steps to Prevent Carbon Monoxide Poisoning and Fires. <https://www.cpsc.gov/Newsroom/News-Releases/2024/As-Winter-Storms-Continue-CPSC-Urges-Families-to-Take-Steps-to-Prevent-Carbon-Monoxide-Poisoning-and-Fires>