

# Carbon monoxide poisoning in the workplace: combustion-powered tools primarily responsible



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Carbon monoxide is responsible for several thousand cases of poisoning every year, including in the workplace. In 2023, poison control centres recorded 49 situations involving 90 poisoned workers. Occupations in construction and public works were the most affected, with the main cause being the use of internal combustion-powered work tools, most often in insufficiently ventilated environments. Information and prevention campaigns need to be stepped up to avoid these potentially serious and even fatal poisoning cases.

## RECURRENT POISONING CASES, INCLUDING IN OCCUPATIONAL SETTINGS

Every year in France, carbon monoxide (CO) is responsible for around 3000 poisonings and around a hundred deaths [1]. This gas is emitted when the combustion process is incomplete, for example due to a faulty boiler or a combustion engine left running. It is odourless and colourless, making it undetectable to victims. Poisoning can lead to coma and death in just a matter of minutes, and if victims survive, they can be left with neurological or cardiovascular sequelae. The first symptoms (headaches, nausea and dizziness) are suggestive, especially if they affect several people in the same place.

Although these poisonings are known for occurring in private homes, they can also affect workplaces, with the possibility of numerous emission sources in a poorly ventilated environment in which the CO can then accumulate. Users can be poisoned by combustion-powered tools or electricity generators, for example. Are they sufficiently informed of the risks involved?

## DOZENS OF CASES OF OCCUPATIONAL POISONING EVERY MONTH

In order to gain a better understanding of the circumstances surrounding these poisonings, data from the poison control centres' information system (SICAP) and the poison control centres' prospective investigation forms<sup>1</sup> were analysed. Situations in which one or more workers had been exposed to the same CO source were reviewed for the year 2023.

A total of 49 episodes were recorded, involving 90 poisoned workers. They were spread throughout the year, with a slightly higher frequency in the autumn and winter months (Figure 1). October and November saw the highest numbers of exposed workers (15 people exposed in seven and six episodes, respectively), followed by January (14 exposed in six episodes).

<sup>1</sup> When contacted by patients or medical services following CO poisoning, poison control centres (PCCs) investigate the cause through an individual medical investigation and provide clinical follow-up for patients. Each event is entered into SICAP and completed using a prospective investigation form that provides a better description of the circumstances and sources of the accident.

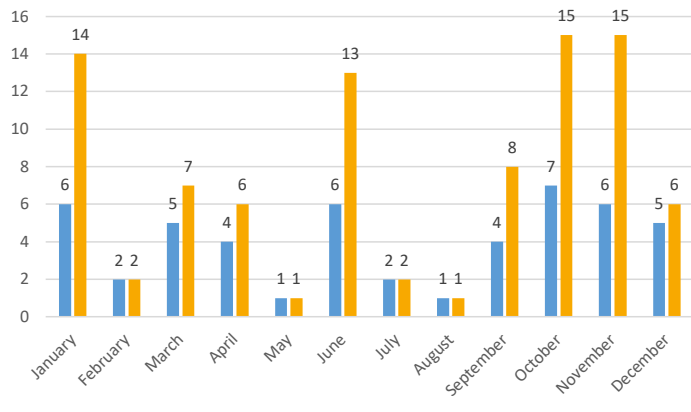


Figure 1 - Distribution over time of the number of episodes (in blue) and workers (in orange) exposed to carbon monoxide in 2023. Source: SICAP.

### MOST CASES DUE TO COMBUSTION-POWERED APPLIANCES

Analysis of the CO emission sources showed that combustion-powered appliances were the main source of poisoning, accounting for 34 episodes and 59 exposed workers (Table 1):

- combustion-powered work tools such as saws, mini-excavators, grinders, high-pressure cleaners and chainsaws, used in poorly ventilated premises,
- electricity generators installed in poorly ventilated premises (garage, attic of a house being renovated, for example), used to supply electricity to equipment such as heaters or cellar pumps,
- exhaust fumes from vehicles such as ambulances or tractors.

These were followed by heating systems, with 10 episodes involving 18 exposed people. They concerned:

- faulty boilers,
- a wood fire lit inside a tent,
- a gas radiant heater used by farmers when working in a hen house.

One episode involving six employees and 45 customers of a restaurant arose from the use of a barbecue inside the kitchen.

Lastly, in four episodes, the source of the CO emissions was not given, but CO poisoning had been confirmed by clinical, metrological or biological evidence: suggestive symptoms, CO measurement in the ambient air at the place where the poisoning occurred, or measurement of blood carboxyhaemoglobin<sup>2</sup> (HbCO) levels [2].

### CONSTRUCTION OCCUPATIONS POSE THE GREATEST RISK

Among the poisoning cases caused by the use of combustion-powered appliances, workers in the construction and public works sector were the most affected. In total, in 2023, 29 episodes involved 54 construction and public works professionals, including:

- tilers who used a tile cutter all day in an enclosed environment,
- painters who connected their spray guns to a generator,
- workers poisoned by fumes from a digger that was faulty but was nevertheless used while waiting for the repair service.

The other episodes involved people working in a CO-contaminated area, but who were not the cause of the contamination. For example:

- a plumber called to service a boiler,
- a gas technician sent to the site of a malfunctioning boiler,
- police officers visiting an unsanitary dwelling with a faulty boiler.

	Number of episodes	Number of poisoning victims
<b>Combustion-powered appliances</b>	<b>34</b>	<b>59</b>
Combustion-powered tools	23	37
Electricity generators	8	13
Exhaust gases from vehicles	3	9
<b>Heating systems</b>	<b>10</b>	<b>18</b>
Boilers	8	15
Gas radiant heaters	1	2
Wood fire	1	1
<b>Barbecue</b>	<b>1</b>	<b>6</b>
<b>Unidentified source</b>	<b>4</b>	<b>7</b>
<b>Total</b>	<b>49</b>	<b>90</b>

Table 1 - Sources of occupational carbon monoxide poisoning in 2023. Source SICAP.

<sup>2</sup> Carboxyhaemoglobin (HbCO) is formed when CO binds to haemoglobin. Distributed throughout the body, it disrupts the supply of oxygen to the organs. The amount of HbCO is expressed as a percentage of total haemoglobin. Physiological HbCO levels are below 3% in healthy non-smoking adults and below 6% in smokers. At higher levels, an exogenous source of CO should be investigated, although the HbCO level should be interpreted with caution. It can be influenced by a number of factors, including the measurement method, the elapsed time between poisoning and blood sampling, oxygen therapy already started at the poisoning site, and certain medical conditions [3, 4].

## SERIOUS POISONINGS AND ONE DEATH

Sixty of the poisoning cases, or two-thirds of the total recorded in 2023, were mild. Headaches were the most frequent symptom, often combined with nausea, vomiting or dizziness. Discomfort, sometimes accompanied by asthenia, was also reported.

Twenty-seven poisoning cases were of moderate severity. Headaches predominated, accompanied by loss of consciousness or convulsions.

Lastly, three workers suffered serious poisoning. This included:

- one who was sandblasting a piece of furniture and was found unconscious with HbCO levels of over 50%,
- two house painters, one of whom died, who were poisoned by an electricity generator on their work site, with CO measured at 1500 ppm at the site<sup>3</sup>.

## DETECTORS RARELY AVAILABLE

In 2023, only four episodes mentioned the fact that a CO detector was present and had been triggered. For 30 of the episodes, no system was in place, while no information was provided in the other 15.

In the four episodes where the detector was triggered, the victims were treated quickly and the poisonings were not serious. These examples also illustrate the diversity of occupational settings posing a risk:

- on the site of a house under construction, a fixed detector was activated due to an accumulation of exhaust fumes,
- at a waste recycling plant, two subcontractors equipped with portable CO detectors were alerted when working near wastewater treatment tanks (the CO emission source was not specified in the dossier),
- in a hairdressing salon, a hairdresser was alerted by a fixed detector to CO emissions from a faulty boiler,
- in an ambulance garage, portable detectors carried in a stationary medical vehicle with the engine running warned of the emission of exhaust fumes.

## INFORMATION AND PRECAUTIONS TO BE REINFORCED

These figures confirm the data already published regionally by the Paris and Angers poison control centres [3, 4]. Between 2005 and 2011 in Île-de-France and between 2016 and 2021 for the North-West region, the occupational sectors affected were similar: manufacturing (factory or workshop staff), building/construction (site workers) or maintenance (technicians). The sources involved were also combustion-powered tools and generators.

These data probably underestimate the incidence of these poisonings, as not all cases are reported to a poison control centre. In addition, other occupational circumstances not covered here can lead to CO exposure: synthesis of chemical raw materials using CO, animal fermentations (such as in pig houses), paper mills, ice rink maintenance, etc. [4].

Workers who use combustion-powered tools in enclosed or poorly ventilated spaces should be reminded of the risk of poisoning. Ventilating the premises is the best solution, but is not always possible. The use of electrically powered tools is an alternative [3].

The annual information campaigns to the general public should also concern the workplace, as many workers may be exposed to faulty boilers or generators that have wrongly been placed in an enclosed space [1].

Lastly, the portable CO detectors already used by certain professionals (gas technicians and firefighters, for example) can provide early warning and limit the risk of poisoning.



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## FIND OUT MORE

[1] **Ministry of Health and Access to Healthcare, Santé Publique France, ANSES, poison control centres. 2024.** Carbon monoxide poisoning can be fatal and concerns everyone: you can reduce the risks by adopting the right practices. Press release. <https://www.santepubliquefrance.fr/presse/2024/les-intoxications-au-monoxyle-de-carbone-peuvent-concerner-chacun-de-nous-et-avoir-des-consequences-dramatiques.-adopter-les-bons-gestes-reduit-les>

[2] **Langrand J. 2024.** Place des examens toxicologiques pour le diagnostic d'une intoxication par le monoxyde de carbone. [The role of toxicological tests in the diagnosis of carbon monoxide poisoning]. *Toxicologie Analytique et Clinique* Vol 36, Issue 3, Supplement, Page S78. <https://doi.org/10.1016/j.toxac.2024.08.015>

[3] **Dos Santos E, Villa A, Garnier R, Dufayet L et Langrand J. 2017.** Surveillance and Analysis of Occupational Carbon Monoxide Poisoning in the Paris Region. *Annals of Work Exposures and Health*, 1–8. <https://doi.org/10.1093/annweh/wxx063>

[4] **Niel J, Descatha A et Deguigne M. 2022.** Acute occupational carbon monoxide poisoning. Updates for occupational practitioner. *Archives des Maladies Professionnelles et de l'Environnement*. <https://doi.org/10.1016/j.admp.2022.03.004>

[5] **Baud F, Garnier R.** *Toxicologie clinique [Clinical toxicology]*. 6<sup>th</sup> edition. Lavoisier. Médecine Sciences.

<sup>3</sup> Convulsive coma and respiratory distress occur after one hour's exposure to 800 ppm CO in air. Death occurs rapidly above 1900 ppm [5].