



## 40 years after Bhopal: lingering health effects and no closure

It has been four decades since the world's deadliest industrial accident, but the impacts are still being felt today. Dinesh C Sharma reports.

On the night of Dec 2, 1984, Rashida Bi, aged 25 years, was fast asleep in her house a short distance from the pesticide plant of Union Carbide in Bhopal. Shortly after midnight, she woke up, coughing and choking. She heard a commotion outside. As her nephew opened the door to check, gusts of poisonous air entered the house. Everybody came out of their homes and started running confusedly. "Soon we were all breathless, nauseating, our eyes swollen, and we were praying to God for a quick death", she said, while recalling the horror of that night.

Rashida not only survived the world's deadliest industrial accident but became the face of the struggle for justice for survivors. Along with another survivor, Champa Bai Shukla, she organised women who had been affected by the disaster to fight for their rights, mobilising protests, including foot marches to Delhi (750 km) in 1989 and 2006. "The gas has left us sick for life. We are seeing its effects in several generations. Our water is poisoned. Despite judicial rulings, we have not received rightful compensation and those responsible for the crime have not been punished. That's why I say that people who died in their sleep on December 2 were lucky", Bi said. Her testimony sums up the continuing plight of Bhopal victims.

That night, 27 tonnes of methyl isocyanate leaked from the Union Carbide pesticide factory, killing 2000 individuals and exposing half a million people to toxic gases. By 1993, another 9667 people had died because of methyl isocyanate-related illnesses, according to court filings based on a 2004 report of the Indian Council of Medical Research (ICMR). In 2012, the Madhya Pradesh Government put the number of deaths at

15248 between 1984 and 2003. Based on annual mortality rates reported by ICMR and other available evidence, Swarup Sarkar—an independent epidemiologist—estimates that an additional 16 434 deaths probably occurred in the exposed group between 1994 and 2000. In an affidavit submitted to the Supreme Court in 2023 in the ongoing case for the payment of compensation, Sarkar observed: "A significant proportion of excess chronic morbidities could be attributed to progressive respiratory and mental health issues for which quantitative data was publicly available", while morbidities such as congenital malformations, metabolic diseases, reproductive disorders, cancers, and kidney diseases need to be carefully studied to estimate the excess burden due to methyl isocyanate exposure.

The continuing debate on the long-term effects of methyl isocyanate exposure is a result of the lackadaisical attitude of government agencies. ICMR established a cohort of 80 000 exposed individuals and 16 000 unexposed individuals in 1985 but ended the project in 1994; its final report was published in 2004. The cohort was handed over to a Madhya Pradesh government agency, the Centre for Rehabilitation Studies, in 1995. It was handed back to ICMR in 2011, when it established the National Institute for Research in Environmental Health (NIREH) to study the long-term effects of methyl isocyanate. By this time, the cohort had lost 79% of individuals in the affected group and 64% in the control group.

While granting free health care as a constitutional right to gas-affected individuals in August, 2012, the Supreme Court directed central and state government agencies to

prioritise research on the long-term effects of methyl isocyanate and appointed an empowered monitoring committee.

In April, 2023, NIREH informed the committee that it had completed 14 studies. "Most of them have not been published and none has been of any therapeutic value for the affected, while uncomfortable ones have been suppressed or abandoned", according to Rachna Dhingra of Bhopal Group for Information and Action.

For example, Dhingra said, an unpublished 2017 study found a seven-fold increase in birth defects among children born to progeny of gas victims, compared with those born to mothers not exposed to methyl isocyanate. "This study was abandoned citing design flaws though the scientific advisory committee of NIREH had approved it earlier", Dhingra said. Moreover, she said, the institute quietly changed its core agenda to more general environmental health in 2019—as reflected in its submissions to the monitoring panel. NIREH's director did not respond to *The Lancet's* query about the studies relating to intergenerational effects.



Activists Rashida Bi (left) and Champa Shukla (right), attend a meeting in Bhopal, April 2004.

Survivor groups estimate that over 150 000 methyl isocyanate-exposed people still battle chronic respiratory, gastrointestinal, neurological, reproductive, psychiatric, and ophthalmic diseases. "It became clear in initial years that hospital-centred and symptomatic treatment was not helping provide sustained relief. A prescription audit showed that 40% of medicines survivors were getting from hospitals were either needless or harmful or both", pointed out Satinath Sarangi, who, in 1995, founded a community-based clinic, Sambhavna Trust, which now has 26 000 methyl isocyanate-affected individuals registered for long-term care.

V Ramana Dhara, a member of the former International Medical Commission on Bhopal, feels that Bhopal-related research had major flaws. "Despite the widely reported multisystemic health effects, a 'Bhopal syndrome' could never be characterised because the constellation of symptoms attributable to the disaster based on exposure-response was not done. Instead of using mortality rates to divide the Bhopal cohort into mild, moderate, and severely affected areas, ICMR could have deployed air dispersion modelling for exposure characterisation and developed an exposure index to assess dose-response relationships", Dhara explained.

The failure to categorise the health impacts of methyl isocyanate exposure as a syndrome with multisystemic effects has serious repercussions. "The affected people were left without a comprehensive treatment plan and science failed to document and provide crucial evidence on long-term and second-generation impacts that could have saved many lives as well as strengthened their legal battle", Sarkar told *The Lancet*. He continued, "No studies were conducted to assess the quality of life of affected communities. They have endured generational gaps in social standing, and face stigma in marriage, employment and other aspects of life."

The site of the disaster continues

to pose health hazards to the local population because it has not been remediated. Since the start of production in 1969, waste was dumped in 21 unlined pits within factory premises and three solar evaporation ponds outside. Over the decades, chemicals leached into groundwater. "Groundwater testing by several government laboratories and action groups from 1990 to 2018 reported dangerous concentrations of heavy metals and chemicals including nine persistent organic pollutants in and around the site", said Dhingra.

The government proposals for clean-up failed to make headway due to a lack of consensus among government agencies and survivor groups. "Dow Chemical which took over Union Carbide in 2001 is liable to clean contamination of soil and groundwater as per the 'Polluter Pays' principle. Instead of pursuing this line of action and proper cleanup, government proposals focused on removing only stored chemicals from the factory or developing a memorial park by pouring concrete over the site", pointed out Rashida, who leads the Bhopal Gas Peedit Mahila Stationery Karmachari Sangh (a survivors' organisation).

Besides facing lingering health effects from methyl isocyanate exposure and groundwater contamination, survivors are still fighting legal battles to assign criminal and civil liability. In 1989, the Indian Government agreed to a US\$470 million settlement with Union Carbide on behalf of the victims and absolved the company of civil liabilities. Although a subsequent court ruling directed the Government to press criminal charges, Union Carbide refused to cooperate, and the extradition of its chairman, Warren Anderson, was stalled by the USA. The Dow Chemical Company maintained the same stand.

In October, 2023, a representative of Dow appeared in the Bhopal court for the first time, only to question the court's jurisdiction. "We are hopeful that the court will enforce the universally accepted

legal principle that the location of a crime confers jurisdiction over the criminal responsible for it", said Madhumita Dutta, a USA-based volunteer of the International Campaign for Justice in Bhopal. Meanwhile, she said, "the burden of providing adequate compensation to survivors must fall upon the Indian government, which is obliged to make up the enormous shortfall in the settlement it agreed with Union Carbide in 1989".

Since the Bhopal disaster, India has developed stricter regulations for industrial safety, hazardous waste management, and pollution control, as well as protocols for handling chemical disasters, but their implementation on the ground remains lax. D Raghunandan of Delhi Science Forum, New Delhi, said, "While a lot has changed since Bhopal, justice for workers and other victims is often denied by powerful state and corporate interests acting in tandem. Trade unions and civil society organisations must realise that immediate or short-term 'victories' following industrial negligence or regulatory non-compliance are just the beginning of continued vigilance and prolonged systemic struggles."

In May, 2020, an accidental leak of styrene gas from the storage tanks of LG Polymers in Vishakhapatnam killed 12 people and injured several thousand in the vicinity. "No proper assessment was made of direct injuries to workers and people, adverse health impacts due to air and water contamination, impacts on livestock and vegetation", noted EAS Sarma, a former civil servant and environment activist. He noted, "Several fatal accidents have occurred after LG Polymers and in none of them, those responsible have been identified and booked for criminal and civil liability." Bhopal remains a grim example of unlearned lessons.

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