SPECIAL REPORT

Counting the dead

Twenty years after the worst nuclear accident in history, arguments over the death toll of Chernobyl are as politically charged as ever, reports **Mark Peplow**.

No more than 4,000 people are likely to die as a result of Chernobyl. That was the conclusion released by the United Nations and the governments of Ukraine, Belarus and Russia in September last year, in the most comprehensive assessment of the accident so far.

But despite promising "definitive" answers the report, based on two decades of research, has done little to resolve the debate over Chernobyl's impact. The estimate drew howls of protest from environmental groups, which accused the UN's Chernobyl Forum of a whitewash. And scientists whose work is cited in the report are concerned about how their figures were presented, pointing out that the true cost of the disaster will not be known for decades to come, if ever.

Chernobyl's runaway nuclear reaction in 1986 was triggered by a faulty safety test, and exacerbated by a design flaw that caused a catastrophic temperature rise in the reactor core. This caused about 6.7 tonnes of radioactive material to spread for hundreds of kilometres around the site. Two of the most significant elements in the chemical cocktail were iodine and caesium, and the most devastating effects were seen within a few tens of kilometres of the reactor, in the region where Ukraine, Belarus and Russia meet.

In the confusion that followed, local families continued to graze and milk their cattle on contaminated land. Many predicted that the accident would cause hundreds of thousands of cancers.

Cooking the books?

The forum reports that the fallout has since caused about 4,000 cases of thyroid cancer, mainly in children and adolescents. But just 15 of these patients have died. Along with highly exposed rescue workers who brought the reactor inferno under control, 62 deaths have been attributed directly to the accident so far.

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The report also says that there has been no significant increase so far in the incidence of other cancers. In total, it said, "up to 4,000 people" may ultimately die as a direct result of the disaster — much lower than previous estimates.

That conclusion upsets many. "The report gave a completely misleading view of the health consequences of the accident," says Ed Lyman, a nuclear-power expert with the Union of Concerned Scientists in Washington DC.

The argument stems from uncertainty about the health effects of low doses of radiation. Evidence from survivors of the atomic bombs dropped on Nagasaki and Hiroshima has allowed researchers to predict the effects of high doses. But as the exposure drops, so does the understanding of its impact. Last year, a working group of the US National Research Council concluded that even tiny amounts of radiation cannot be considered safe.

In contrast, the forum based its headline figure on just the 600,000 people exposed to the most radiation, predicting that roughly 4,000 of them will die as a result. The full report acknowledges that, of 6.8 million others living further from the explosion who received a much lower dose, Chernobyl will kill another 5,000 — more than doubling the projected death toll. But this is not mentioned in the report's 50-page summary or the accompanying press release.

The figures come from a study published in 1996 by Elizabeth Cardis of the International Agency for Research on Cancer in Lyon, France. "I was very shocked that they were quoting figures we had found ten years ago," says Cardis. "I didn't expect the numbers to be picked up and used in a press release without qualification."

Even the forum's chair, Burton Bennett, former head of the Radiation Effects Research

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Foundation in Hiroshima, Japan, says caveats about the figures should have been clearer. But he points out that the extra 6.8 million people were, on average, exposed to a radiation dose of just 7 millisieverts — little more than the natural background delivers in a year in most parts of the world.

Melissa Fleming, a press officer working at the International Atomic Energy Agency in Vienna, who helped coordinate the report's publicity, says the scientists involved checked the press material. But she admits a decision was made to focus on the lower 4,000 figure, partly as a reaction to the inflated estimates of past decades. "I was sick of seeing wild figures being reported by reputable organizations that were attributed to the UN," she says. "It was a bold action to put out a new figure that was much less than conventional wisdom." The figure has been removed from the final summary, however, published this month.

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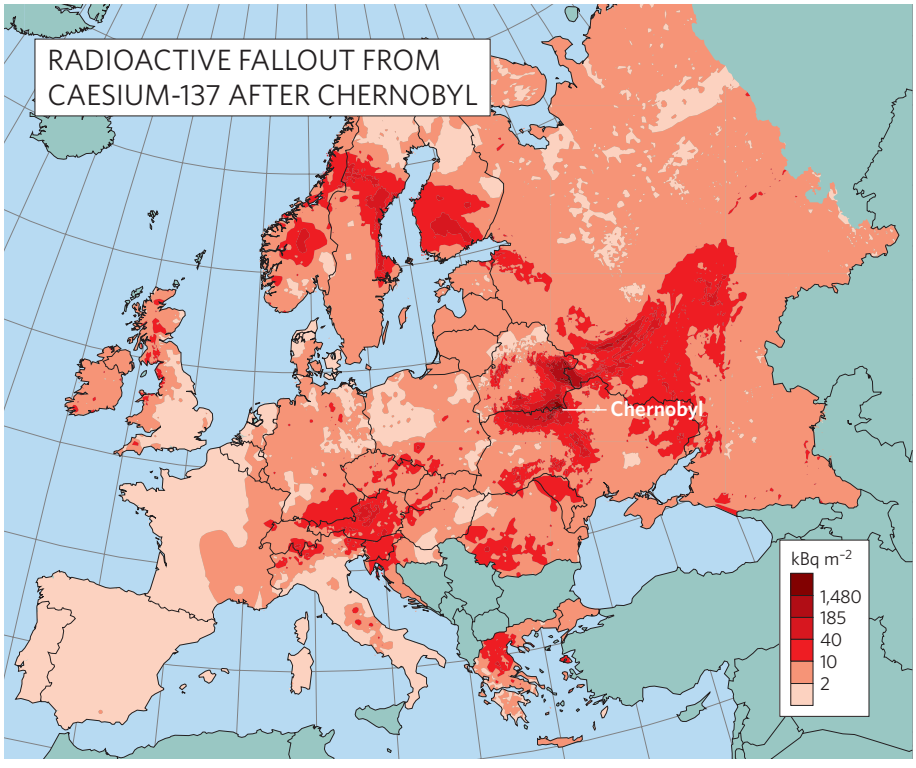
Uncertain legacy

Some of the higher death tolls come from those who believe that estimates of those potentially affected should extend to everyone in Europe (see map). In a report commissioned by Green Party members of the European Parliament, radiation scientist Ian Fairlie calculated that of the hundreds of millions of people who could possibly have received any radiation at all from Chernobyl, 30,000–60,000 could die as a result (see http://tinyurl.com/rpzsq).

Cardis is also about to publish a study of the pan-European impact. She concludes that, of 570 million people in Europe at the time, 16,000 will ultimately die as a result of the accident — 0.01% of all cancer deaths. But she says it will be virtually impossible to assess the ultimate death toll. Cancer causes about a quarter of all deaths in Europe, so weeding out those cases triggered by Chernobyl cannot be done with statistical confidence. "We'll never be able to say whether we were right or not," she says.

Some researchers also take issue with the report's conclusion that there are no hereditary effects in children born after the disaster. "The fact that we haven't seen anything doesn't mean there isn't an effect," says Cardis. "It's just too early to see an increase."

Until Chernobyl survivors' children and grandchildren grow up, the only way to assess such effects is to look for DNA mutations. Yuri Dubrova, a geneticist at the University of Leicester, UK, has found increased genetic changes in the children of irradiated parents — but the fingerprinting technique he used only allowed him to look at non-coding regions, known as junk DNA (Y. E. Dubrova *et al. Nature* **380,** 683–686; 1996).



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He argues that coding regions are also likely to be affected. DNA chips currently being developed will allow mass screening of samples from thousands of people, he says, and could pick up effects too small to have been spotted so far. "The real necessity now is to organize proper blood-sample banks," he says.

Many are calling for research to track effects such as cancer or infertility in subsequent generations (see page 993). But although such monitoring is seen as essential, some worry that wrangling over death tolls and radiation risk is hampering survivors' recovery.

Against apathy

"What we'd like people to take away is not the numbers game," says Louisa Vinton, who manages Chernobyl projects at the United Nations Development Programme (UNDP). Rough estimates of death tolls allow governments to set up policies to manage the future health effects. But she says the focus on the figure of 4,000 obscured a more important message of the report: that myths about the threat of radiation have created a "paralysing fatalism" among residents of affected areas.

Instead Vinton hopes that Chernobyl's legacy can be seen as a social problem. The UNDP says that Chernobyl's most serious impact was on the mental health of about 7 million people labelled as victims of the accident. Aid from the governments of Russia, Belarus and Ukraine has created a culture of dependency, it argues, which may have encouraged exaggerated fears of ill-health.

"We go to communities where people have just given up," says Vinton. Poor diet, lack of exercise and smoking are all linked to such apathy. She admits it is hard to separate the stress of Chernobyl from the effects of collapse of the Soviet Union. But Chernobyl aid has drained resources. In 1991, Belarus spent 22.3% of its budget on aid; today that figure is still 6%.

The forum's report recommends that governments reassign the cash towards regenerating the region and developing infrastructure.

The hottest spots will be radioactive for centuries. But the most prevalent isotope, caesium-137, has a half-life of about 30 years and scientists estimate that much of the abandoned area will become habitable over coming decades. The 30-kilometre exclusion zone around Chernobyl is likely to remain off limits. But the report suggests that in other evacuated areas roads should be rebuilt, and people encouraged to start farms and businesses.

Projects to build hospitals and schools are already helping people to help themselves, says Vinton: "I've seen the before and after. People stand up straight and bubble over with excitement about the next plan." ■