Correspondence

License gene edits like cannabis

As an author of the Nuffield Council on Bioethics' 2018 report on genome editing and human reproduction, I wonder whether action to regulate editing of the human germ line might be guided by cannabis regulation (see *Nature* **570**, 137; 2019).

In my view, a moratorium on the technology would be regulatory theatre (see E. Lander *et al. Nature* **567**, 165–168; 2019). CRISPR gene editing is cheap and easily accessible, and its practice and products are hard to detect. Like cannabis prohibition, a moratorium risks fostering a black market in unregulated and potentially harmful 'products', in this case heritable gene variants.

Might it therefore be safer from a public-health perspective to permit access to licensed human-genome editing that meets acceptable standards? A new committee set up by the World Health Organization (see *Nature* **567**, 444–445; 2019) is already doing important work to set such standards. So, too, is an international commission convened by the UK Royal Society, the US National Academy of Sciences and the US National Academy of Medicine.

As with medical applications of cannabis, legal uses of heritable genome editing would still need ethical approval, and informed public debate must be advanced. Public information campaigns indicating that research into genome editing is at an early stage, and that unapproved experimentation is both risky and illegal, would provide a practical first line of defence against malpractice.

To further ensure responsible governance, legislatures need to advance research on editing human embryos. The UK's 14-day limit should be extended to permit studies of later-stage human embryos. Research applications should not be impeded by CRISPR exceptionalism, for which there is no legal basis.

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**Competing interests declared; see go.nature.com/2xrm2wh.*
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Explain ill effects of airborne particles

Resolving the argument in Washington over the need to reduce airborne-particle emissions in the United States will not clean up the air in India or China (see *Nature* **568**, 433; 2019). Research on air pollution should move beyond statistical analysis of premature deaths to demonstrating measurable human-health benefits from cleaner air. We therefore need more data on victims' exposures and the long-term mechanisms for specific causes of death.

Outdoor (but not indoor) air pollution is currently assessed by monitoring concentrations of regulated air pollutants — including particles — the adverse effects of which are gauged according to their size. To track their physiological impact after inhalation, we need a paradigm similar to that originally used for tobacco toxins: identify the hazardous constituents, determine the latent period before disease development, and assess the cumulative effects of long-term exposure.

For example, ammonium sulfate — a principal ingredient of $PM_{2.5}$ particles — has been associated with ischaemic heart disease, as have particles from diesel engines. Successful interventions depend on knowing how such particles could penetrate the lung–blood barrier and cause adverse health effects.

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Impacts of Belt and Road in the Arctic

Infrastructure expansion and energy exploitation in the Arctic under China's Belt and Road Initiative (BRI) could affect climate as well as key ecosystems (see *Nature* **569**, 5; 2019). These huge projects risk accelerating carbon release by inducing permafrost thaw (see, for example, M. Turetsky *et al. Nature* **569**, 32–34; 2019). In our view, international monitoring of the situation is necessary so that such changes can be incorporated into holistic climate-change assessments.

Almost one-quarter of the world's gas and oil reserves are in the Arctic, earmarked for development in China's US$1.3-trillion BRI. The initiative has allocated $12.1 billion to the flagship Yamal liquefied-natural-gas project, $25 billion to a 4,857-kilometre oil pipeline between eastern Siberia and the Pacific Ocean, and $6.1 billion to a 762-kilometre Moscow–Kazan high-speed railway. It seeks to expand Arctic shipping along the northern sea route between China and Europe and to build bases in Greenland.

Global warming and permafrost melt have already destabilized existing infrastructure, including the railway from Beijing to Lhasa. Extraction and use of raw materials will further exacerbate carbon emissions, requiring new mitigation measures.

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Forests: optimizing carbon uptake

We question Simon Lewis and colleagues' contention that natural forests could sequester 40 times more carbon than commercial plantations (*Nature* **568**, 25–28; 2019).

Their model of carbon uptake hinges on how long forests persist once they are established. They assume that plantations established in 2015 go through a single harvest rotation (10 years for most countries) and then disappear and remain carbon-neutral until 2100. And they assume that natural forests that are regenerating would begin to recover in 2015 and then continue to grow until 2050 or 2100. However, the difference in carbon-sequestration estimates between reforestation strategies changes markedly when either assumption is relaxed.

Literature estimates for the half-life of naturally regenerating tropical forests range from 3 to 20 years (J. L. Reid *et al. Conserv. Lett.* **12**, e12607; 2019). Less than half of restored tropical forests are therefore likely to persist until 2050. Moreover, timber-plantation managers would probably carry out multiple replanting rotations, and carbon from timber products is not automatically released into the atmosphere.

If creating more plantations drives down timber prices, as Lewis and colleagues imply, it would ease commercial pressure on natural forests (see, for example, J. Ghazoul *et al. Nature* **570**, 307; 2019). Furthermore, abandoned plantations could promote natural forest regeneration and net carbon storage.

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