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DIYbio gets a poxy rap

Contrary to alarmist headlines, the DIYbio movement is an unlikely biosecurity threat.

The 'do-it-yourself' biology (DIYbio) community has had its share of sensationalist headlines exaggerating potential concerns and dangers associated with its work. The latest example came in a *New York Times* piece ("As D.I.Y. gene editing gains popularity, 'someone is going to get hurt,'" May 18, 2018) that conflated work to construct a horsepox virus from synthetic DNA fragments (*PLoS ONE* **13**, e0188453, 2018) with "sounding the alarm about genetic tinkering carried out in garages and living rooms." It did not matter that the horsepox experiments were carried out in a traditional academic laboratory at the University of Alberta and *not* in a garage or living room. Nor that the horsepox experiment did not use gene editing. Nor that there are few if any DIYbio spaces capable of carrying out the type of complex experiments required to reconstruct horsepox. *The New York Times* simply chose to link the DIYbio community with the controversial horsepox experiments to illustrate that "someone somewhere will use the spreading technology to create a bioweapon."

DIYbio is an easy target for scare stories because it remains something of an unknown. According to the Brookings Institution, there are over 169 DIYbio spaces and as many as 32,500 enthusiasts and followers around the world. These amateurs are part of a rapidly growing social movement in which citizen scientists come together to apply a set of hacking principles to biology—principles that include sharing, openness, decentralization, and free access, all with the goal of world improvement.

Professional scientists often remain dismissive of biohackers, distrusting their lack of training, equipment, facilities, and know-how. Regulators are critical about DIYbio products and kits that enable self-experimentation and treatment—so-called body hacking. But it is law enforcement agencies, such as the Federal Bureau of Investigation, that focus on biosecurity issues and the potential threat of DIYbio as a source of bioerror (accidental release) or bioterror (malign purpose).

A catastrophic release via bioerror appears unlikely. Most biohackers work on *Escherichia coli* or yeast—organisms adapted to life in the laboratory and lacking the fitness to survive in the field.

DIY bioterror also seems a long shot. If a rogue biohacker were to seek to create a pathogen from scratch using mail-order DNA fragments, for example, they would likely face a long, uphill struggle. Unlike David Evans' group at the University of Alberta who made the synthetic horsepox, a DIYbio hobbyist is unlikely to convince DNA synthesis companies like GeneArt to ship DNA flagged with "homology to a known pathogen" to their home address. Even if one assumes the biohacker could obtain pathogen DNA without being flagged, the likelihood is low they would have the necessary equipment, containment facilities, or know-how to create a synthetic pathogen (e.g., like horsepox) in their garage or living room. This is difficult work even for trained professional researchers with sophisticated instruments and technical and financial support provided by a traditional institution.

A final aspect that seems to have escaped *The New York Times* journalists is the strong ethical, open, and transparent culture of DIYbio groups (e.g., see https://diybio.org/codes/) and their proactive attitude to addressing biosafety and biosecurity concerns. Most DIYbio activity is group-based, and these communities not only reinforce altruistic behavior but also would likely spot individuals with nefarious intentions working within their ranks.

Of course, with all the above in mind, it is not impossible that a lone-wolf biohacker could make a synthetic pathogen. But it seems exceedingly unlikely—at least for now. DIYbio has a lot to offer the bioengineering community; it is disappointing that *The New York Times* sought to overhype its risks rather than explore the movement's potential for low-resource innovation, public engagement, and education.

Human embryo research policy update

Ethics standards for studies that report human embryo and stem cell research.

Ethics regulations governing research with human embryos, gametes, and embryonic stem cells vary considerably among countries. The International Society for Stem Cell Research (ISSCR) has long sought to raise and harmonize ethical standards in the field, and two years ago published recommendations for scientists in its *Guidelines for Stem Cell Research and Clinical Translation*. In support of efforts by the ISSCR and other stakeholders to promote the ethical conduct of stem cell research, Nature journals have released an updated policy (https://www.nature.com/authors/policies/experimental.html). The policy, which formalizes and refines longstanding editorial practices, encourages scientists to adopt the ISSCR guidelines. For manuscripts submitted to *Nature Biotechnology* and other Nature journals, it defines the types of study requiring an ethics statement and a smaller group of studies requiring both an ethics statement and review by an ethicist.

The ISSCR guidelines prescribe categories of research that warrant specialized review through a "human embryo research oversight (EMRO) process." In line with this objective, our policy requires an ethics statement, backed by EMRO-type review, for manuscripts in the following areas: (i) research on human embryos and gametes, (ii) research on animal–human chimeras where human cells may contribute significantly to the host central nervous system or gametes, and (iii) clinical studies in which human subjects are donors or recipients of embryos, gametes, or cells derived from pluripotent stem cells. The ethics statement should report the review boards that monitored the research and the conditions of cell donation and transplantation, including informed consent.

The editors will consult an ethicist reviewer alongside the scientific peer review for papers describing especially sensitive research, such as genome engineering of human embryos or gametes, culture of human embryos or embryo-like structures for around 14 days (*Nat. Biotechnol.* **35**, 1029–1042, 2017), and clinical studies with cells derived from pluripotent stem cells. As in the past, research prohibited according to current ethical consensus (e.g., human reproductive cloning) will not be sent for peer review or published.