Correspondence

Gear students up for big medical data

Combining big data with personalized medicine is an unprecedented opportunity. It will probably be cheaper than current practices in the long term, particularly given the questionable effectiveness of many medications (see *Nature* **517,** 540; 2015).

Success in this endeavour will depend on training the next generation of clinicians and data scientists to deploy terabytes of data to select from a range of diagnosis and treatment options.

Undergraduate and graduate bioinformatics programmes need to embrace data-analytics courses geared towards generating a new type of medical specialist — one who no longer needs to see patients, just their data.

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Antibodies: the solution is validation

I disagree with Andrew Bradbury and colleagues' suggestion that making the sequences of commercial antibodies publicly available could minimize irreproducibility in biomedical research (*Nature* **518,** 27–29; 2015). The real solution is proper initial validation of antibodies.

In my view, the reproducibility problem is better addressed by identifying the good antibodies and the reputable companies that develop, validate and manufacture them — as astute scientists do now. Also, journals need to mandate the provision of detailed validation data, protocols and antibody sources (clone, catalogue number). Independent websites enabling the submission of antibody data and consumer feedback would also help.

The biggest investment in developing a good monoclonal antibody is the extensive work needed to validate specificity and sensitivity across all relevant applications. Unlike therapeutic antibodies, most research antibodies are not sequence-patented because the cost is too high to be recovered by sales.

Even if the practical hurdles of funding and enforcing a sequence-publishing policy could be overcome, making unpatented antibody sequences public would allow them to be widely copied, produced and sold. This would eliminate the incentive for good companies to invest in validation. It would also allow 'bad' antibody sequences to contaminate the databases.

The authors' proposal could therefore disproportionately harm the good companies, hurt the end-users it is designed to protect, and would not solve the reproducibility problem.

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Antibodies: validate recombinants too

Recombinant antibodies are pure proteins with minimal batch-to-batch variability, so could provide an important element of antibody standardization (A. Bradbury *et al. Nature* **518,** 27–29; 2015). However, they must still be functionally validated if they are to help solve the reproducibility crisis.

Vendors and researchers would have to optimize their recombinant antibodies for specific applications, because of the inherent complexity of these molecules and their ability to bind non-specifically to other proteins carrying similar immunological sequences.

Suppliers and users of such antibodies will need specialized training in this validation and optimization, particularly in experimental design and the extensive use of controls.

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Polluters migrate to China's poor areas

Bo Zhang and Cong Cao argue that China's citizens should have a legal right to safeguard the quality of their environment (*Nature* **517,** 433–434; 2015). The wealthy would stand to benefit most from such a public litigation system, causing pollution producers to migrate to poorer areas.

Heavy industry in China is already moving out of developed eastern regions to the west (see X. Bai *et al. Nature* **509,** 158–160; 2014), where it is damaging the local ecology. Industrial waste slag has eroded a nature conservation area in Xinjiang (see go.nature.com/68e1lo; in Chinese), for example, and discharge from factories has severely polluted part of the Tengger Desert at the border of the Inner Mongolia and Ningxia regions (see go.nature.com/nlfbrs; in Chinese).

Environmental activism by residents in affluent areas such as Shenzhen, Jinan and Beijing (see, for example, Q. Wang *Nature* **497,** 159; 2013) is accelerating this migration of polluters into poor areas where environmental protection is considered a luxury, and where water and soil are already badly contaminated.

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Biochar: bring on the sewage

Biochars are carbon-rich soil additives derived from agricultural and other plant waste that could enhance crop productivity (see *Nature* **517,** 258–260; 2015). We suggest that biochars could also be produced from human sewage — an underutilized resource that is rich in soil nutrients and carbon.

Sanitation problems in developing regions would be alleviated by diverting sewage solids into producing biochar, made by thermal conversion in sealed containers. This might even offset the need to install conventional sewage-treatment infrastructure with its higher construction and operation costs.

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Biochar: pros must outweigh cons

To optimize the agricultural and environmental benefits of biochar, a charcoal-rich soil additive, we need to overcome its potentially undesirable effects (see *Nature* **517,** 258–260; 2015).

For example, it is uncertain whether biochar — effectively an underground carbon store — can help to mitigate carbon emissions. A ten-year study of boreal forests found that applying biochar led to soil degradation and increased the activity of soil microbes, causing carbon dioxide release (D. A. Wardle *et al. Science* **320,** 629; 2008).

Adding blackened biochar can also lower the reflectivity (albedo) of the soil surface, potentially exacerbating climate warming (S. Meyer *et al. Environ. Sci. Technol.* **46,** 12726–12734; 2012).

Tilling deep furrows in the soil would help to reduce the decline in reflectivity and increase the efficiency of applied biochar. However, this practice could also encourage carbon dioxide release.

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