Must try harder

Too many sloppy mistakes are creeping into scientific papers. Lab heads must look more rigorously at the data — and at themselves.

Science: Branch of knowledge or study dealing with a body of facts or truths systematically arranged. So says the dictionary. But, as most scientists appreciate, the fruits of what is called science are occasionally anything but. Most of the time, when attention focuses on divergence from this gold (and linguistic) standard of science, it is fraud and fabrication — the facts and truth — that are in the spotlight. These remain important problems, but this week *Nature* highlights another, more endemic, failure — the increasing number of cases in which, although the facts and truth have been established, scientists fail to make sure that they are systematically arranged. Put simply, there are too many careless mistakes creeping into scientific papers — in our pages and elsewhere.

A Comment article on page 531 exposes one possible impact of such carelessness. Glenn Begley and Lee Ellis analyse the low number of cancer-research studies that have been converted into clinical success, and conclude that a major factor is the overall poor quality of published preclinical data. A warning sign, they say, should be the "shocking" number of research papers in the field for which the main findings could not be reproduced. To be clear, this is not fraud — and there can be legitimate technical reasons why basic research findings do not stand up in clinical work. But the overall impression the article leaves is of insufficient thoroughness in the way that too many researchers present their data.

The finding resonates with a growing sense of unease among specialist editors on this journal, and not just in the field of oncology. Across the life sciences, handling corrections that have arisen from avoidable errors in manuscripts has become an uncomfortable part of the publishing process.

The evidence is largely anecdotal. So here are the anecdotes: unrelated data panels; missing references; incorrect controls; undeclared cosmetic adjustments to figures; duplications; reserve figures and dummy text included; inaccurate and incomplete methods; and improper use of statistics — the failure to understand the difference between technical replicates and independent experiments, for example.

It is usually the case that original data can be produced, mistakes corrected, and the findings of the corrected research paper still stand. At the very least, however, there is too little attention paid and too many corrections, which reflect unacceptable shoddiness in laboratories that risks damaging trust in the science that they, and others, produce.

The situation throws up many questions. Here are three of them. Who is responsible? Why is it happening? How can it be stopped?

The principal investigators (PIs) of any lab from which the work originates, especially if their names are on the paper, have an absolute and unavoidable responsibility to ensure the quality of the data from their labs, even if the main work is done by experienced postdocs. Officially, postdocs and graduate students are still in training, and it is the PI's job to make sure they are properly trained — in statistics and appropriate image editing, for a start. It is unacceptable for lab heads —who are happy to take the credit for good work — to look at raw data for the first time only when problems in published studies are reported.

In private, scientists who run labs in even the most prestigious universities admit that they have little time to supervise and train all their students. Institutions such as the European Molecular Biology Laboratory in Heidelberg, Germany, have maximum lab sizes for this reason. Funding agencies should require grant applicants to indicate lab size and offer adequate supervision. As is the case in commercial companies, larger labs should introduce formal training and a management hierarchy, with more experienced postdocs and research associates required to sign off data and experiments if PIs cannot do so themselves.

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What can journal editors and referees do? Sloppiness is sometimes caught, but so much must be taken on trust. Journals should certainly offer online commenting, so that alert readers can point out errors. Where comments or corrections appear in other journals, these should be linked from the original paper — as the Comment authors recommend.

There should also be increased scope to publish fuller results from an experiment, and subsequent negative or positive corroborations. There is an opportunity here for 'minimum threshold' journals, such as *PLoS ONE* and *Scientific Reports*. Editors and referees cannot be expected to divine when only positive data are included and inconvenient results left out, but journals should encourage online presentation of the complete picture. And scientists should offer it. The complete picture is, after all, what this science of ours strives to provide. ■

Under surveillance

Global systems for monitoring threats from flu need a radical overhaul.

Imagine a global weather and climate forecasting system that collects data regularly in just a handful of countries, and takes measurements elsewhere only during extreme weather events. That is what today's global flu-surveillance system mostly looks like.

The shortcomings of flu surveillance have long been recognized (see *Nature* **440,** 6–7; 2006), but they are attracting renewed attention following the creation in labs of strains of the H5N1 avian influenza virus that can spread between mammals. The main cited public-health benefit of the research is that it will allow for monitoring for such mutations in the wild, and give a remote chance of containing an emerging pandemic.

It is certainly urgent to monitor wild flu strains for mutations that might make them transmissible between mammals (see *Nature* **482,** 439; 2012). But as Malik Peiris, a flu virologist at the University of Hong Kong, says, detection of a breaking pandemic is "a very ambitious goal, and this is where vastly enhanced global surveillance is needed".

Current surveillance can barely identify threats, let alone track them. The precursor to the H1N1 virus that caused a pandemic in 2009 had been circulating worldwide for years in pigs, and the pandemic virus had been infecting humans in Mexico for months, before either was detected. That virus is also a reminder that threats come from many flu subtypes other than H5N1.

An analysis by *Nature* shows that timely, continued and representative global surveillance of the genetic sequences of flu isolates from pigs and poultry just isn't happening (see page 520). From 2003 to 2011, most countries collected few or no sequences, and genetic surveillance of flu in pigs was and is almost non-existent. There is typically a lag of years between collection of viruses and the release of their sequences into public databases, so there are very few data on their recent evolution.

Yet the analysis gives hope that this situation could be rectified, given political will, modest funding and international coordination. Hong Kong has collected the most flu sequences from pigs after the United States and China, and most of those come from labs at the University of Hong Kong, including Peiris's; this shows what a few dedicated centres can achieve. Similarly, the Influenza Genome Sequencing Project of the US National Institute of Allergy and Infectious Diseases, which was launched in 2004 and sequences whole flu genomes from isolates collected globally, accounts for around half of sequences generated worldwide. And in the past decade, many nations affected by H5N1 have greatly improved their surveillance, often despite limited resources and poor veterinary and health infrastructure.

More sequencing alone is not enough. Sequences tend currently to come in fits and starts, in response to an outbreak, one-off projects or as funding allows, and there is little sustained passive surveillance. Global, scientific and representative sampling is needed, from multiple outbreaks and diverse populations, taking into account risk factors such as the size of livestock populations, husbandry practices and proximity to waterfowl reservoirs.

"Current surveillance can barely identify threats, let alone track them."

Funding is not the only problem. Few countries, for example, compensate for culled animals to encourage farmers to report outbreaks; and some might conceal, or not actively look for, flu infections for trade reasons. Nations can be reluctant to share viral isolates if they do not get anything in return, although the World Health Organization's Pandemic Influenza Preparedness Framework, published last year, should help to ensure that they do get appropriate benefits, including access to vaccines.

Surveillance makes sense even without the promise of tracking a pandemic. Detecting outbreaks in livestock allows control through culling or vaccination to avoid crippling losses, and limits the opportunities for viruses to mutate, outpace vaccines and possibly turn pandemic. Surveillance also generates crucial data for epidemiology and drug-resistance monitoring, yet it remains a low priority. Sequencing costs can fall all they like, but without greater, and more sustained, routine surveillance efforts, there will be few samples to sequence. ■

Food for thought

In the short term, chemical fertilizers are the best way to feed Africa.

Chemical fertilizers get a bad press, with some justification. Their use can pollute water supplies and generate significant greenhouse-gas emissions. But they are an excellent way to boost crop yields: they help to grow food. And in sub-Saharan Africa that means they can help to fill empty bellies and save lives.

Parts of Africa sorely need that help. Across the continent, agricultural lands are characterized by red soil that is low in nutrients. Intensive farming has seen the typical hectare of sub-Saharan farmland lose 22 kilograms of nitrogen, 2.5 kg of phosphorus and 15 kg of potassium annually over the past 30 years. Impoverished African farmers cannot afford to wait for the international community to deliberate on the long-term, green methods needed for a sustainable global agricultural system. They need to deploy methods that work now — and that means that in the short term, they need access to chemical fertilizers.

But there lies the problem. Most of the Malawian farmers interviewed for the Feature on page 525, for example, said that their biggest problem is the high cost and poor supply of fertilizer.

Although this evidence is anecdotal, it hints at something more. Farming a smallholding is intensive, backbreaking work that, for the most part, is done out of necessity, not choice. Greener practices such as no-till farming may be cheaper than using fertilizer, but they are less efficient and lack appeal because they add to farmers' already hard labour. By contrast, the quick and easy gains of fertilizers free up farmers' time, and can turn a subsistence existence into a commercial operation, offering a potential way to escape the crushing cycle of poverty.

Africa is not a laboratory in which to investigate and promote alternative agricultural strategies at the expense of those that are known to work. Development efforts need instead to focus first on the problems of fertilizer supply and cost. Without fertilizers, it is hard to see how African farmers can catch up with their counterparts in Europe, North America and Asia, all of whom benefited from the boost chemicals gave their agricultural enterprise.

Subsidies are a key way to tackle this problem. It is encouraging that economists, including some at the World Bank, are recognizing that subsidies can help private-sector development, as demonstrated by Rwanda's agriculture-support programme, which meets some of the costs of fertilizer transport. Still, last week's *coup d'état* in Mali is a worrisome reminder of the political volatility in some parts of the continent, which can make donors reluctant to inject more cash because they fear that it will not reach its intended target.

There are other financial tools, too. Kenya's Equity Bank, for example, set up a loan system in 2008 to help farmers buy fertilizer. It lends the farmers cash at the start of the agricultural season, when they need fertilizer most but are least able to afford it, and allows them to pay back the loan at harvest time, when they sell their crop.

Improved access to fertilizer, although essential at present, is not the best long-term solution. Research must continue to reduce reliance on chemicals and to make their use more efficient. As highlighted on page 525, accurate and detailed information being gathered on soil types and health can allow for more precise and appropriate fertilizer application. Work is also needed to reduce the thirst of crops for fertilizer, and further improvements could be made by manipulating the soil and microorganisms around plant roots to increase the amount of dissolved nitrogen available to the crops.

Ultimately, the move towards a more sustainable form of agriculture will require investment to help farmers in Africa take advantage of alternatives to chemical fertilizers, although they will need to be convinced of the benefits of these new approaches.

The key to success is for farmers to choose the practices that will work best for them — past development efforts have shown that without buy-in from local communities, initiatives simply don't work. For now, that has to mean improved access to fertilizers, because the choice between food and famine is an easy one. ■

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