and have sent epidemiologists to detect the source of the outbreak, and to locate the contacts of patients who may have the disease."

Outbreaks of Lassa fever occur regularly in West Africa, where the virus is carried by rats. A person infected with the virus can spread it to others through their blood, urine and other bodily fluids. Symptoms of the disease include fever — and, sometimes, internal bleeding that can lead to death.

The 2014–16 epidemic of Ebola, a virus that can cause similar deadly symptoms, accelerated the transformation of the NCDC. The agency launched in 2011 with medical staff that lacked epidemiological training or the authority to act fast to curb outbreaks, says NCDC chief executive Chikwe Ihekweazu, who works in Abuja.

Nigeria became part of the Ebola epidemic in July 2014, when a man infected with the virus entered the country in Lagos, Nigeria's largest city. Although only 19 people in the country ultimately became infected, many Nigerians felt their country had narrowly skirted disaster. The man in Lagos visited a renowned private clinic where he was diagnosed immediately. That might not have happened had he entered one of the general hospitals that serve much of Nigeria's population, and often lack equipment, doctors and nurses.

In addition, international health organizations were poised to assist Nigerian authorities because they had already been alerted to the escalating Ebola crisis in Liberia, Sierra Leone and Guinea.

"We were very lucky," says Ihekweazu, who took the NCDC's helm in 2016 and has changed how it operates. He convinced politicians to grant the agency more autonomy to provide top government officials with information on outbreaks, without concern for the political ramifications. Ihekweazu has also improved how the NCDC interacts with the public. The agency uses television, radio and social media to educate people about public health; that includes combatting false information about how diseases such as Lassa spread.

***"Sometimes things need to get worse before they get better."***

"We are not where we want to be, but we are miles ahead of where we were," Ihekweazu says.

## DISEASE DETECTIVES

Now, the agency's public-health researchers are trying to understand why the current Lassa outbreak is so extensive. The scientists are collecting samples of the virus to see whether it has become easier to transmit; they are also exploring other hypotheses, such as whether people are living in closer contact to the common African rats (*Mastomys natalensis*) that can carry the virus.

NCDC workers are also building long-term infrastructure and systems to battle this outbreak and those to come. The agency is coordinating its response at an emergency-operations centre that is modelled on "war rooms" deployed during polio outbreaks and the Ebola epidemic. Staff members are monitoring suspected and potential cases using software called SORMAS, which runs on tablet computers and smartphones. It was developed in response to the plodding pen-and-paper method used to track Ebola.

Yet the NCDC still faces some significant challenges. Many Nigerian states lack facilities to quickly diagnose diseases such as Lassa and Ebola, Ukwaja says, making it harder for the public-health agency to fight outbreaks from the start. In January, three of his colleagues at the hospital in Abakaliki died of Lassa fever. They were exposed to the virus during a four-day wait for test results from samples that had to be shipped out of the state for processing.

Now, that wait has been cut to 24 hours, because the NCDC has built a laboratory in Ebonyi state that has the equipment needed to identify Lassa fever. The facility, which began operating last week, is the fourth such lab in Nigeria.

"Sometimes things need to get worse before they get better," says Richard Garfield, an epidemiologist who advises the US Centers for Disease Control and Prevention. "Pretty much everything big we have done in epidemiology was in response to a problem we didn't know how to handle." ■

PUBLISHING

# Sites warn against 'predatory' journals

*Blacklists emerge after closure of popular Beall's list.*

BY DALMEET SINGH CHAWLA

When librarian Jeffrey Beall shut down his controversial blog listing potentially 'predatory' scholarly publishers and journals last year, copies swiftly appeared elsewhere online. More than a year later, at least one of these copycat blacklists is still growing — maintained by an anonymous website manager who says that they spend hours each weekend working on the list.

Growing interest in the site suggests that there is still an academic appetite for a public blacklist of predatory journals, says the site manager, who identified themselves as a senior research assistant in the hard sciences at a European institution. The site's keeper corresponded with *Nature* by e-mail and declined to provide any further details of their identity, citing fear of harassment.

Beginning in 2010, Beall, an academic librarian at the University of Colorado Denver, maintained a site listing thousands of open-access journals and publishers that he said deceived authors by charging fees to publish papers without providing expected services, such as peer review and editing. He closed the site in January 2017, and later said that this was because of "intense pressure" from his employer — although his supervisor and institution have denied this, calling it Beall's personal decision.

Sites preserving Beall's list quickly surfaced. The anonymous site manager says that their own page, titled 'Beall's list of predatory journals and publishers', was initially intended only for personal use. But soon after the site went live, they began receiving e-mails from academics asking about the quality of certain journals. The manager now spends four to six hours each weekend replying to these messages, and says that most questions come from academics concerned about publishing in a particular journal.

If the journal titles aren't already listed, the manager says, they carry out an "in-depth analysis" of the publishers' policies, checking them against a set of criteria originally laid out by Beall, and researching whether they are indexed on journal 'whitelists', such as the Directory of Open Access Journals or Journal Citation Reports. Journals or publishers deemed untrustworthy by the manager are included in an 'update' addendum on the blog. By March 2018, the new site had added 85 stand-alone journals and 27 publishers to Beall's original lists of more than 1,000 titles.

## LISTS OF LISTS

Another site, Stop Predatory Journals, also came online in January last year. It is run by a group that, according to the website, consists of scholars and information professionals who decided to "rebuild and resurrect" Beall's list, hoping to create a community-based approach to curation. But the site is not updated regularly.

"I understand their desire to be anonymous," says Beall, who says that publishers listed

on his site frequently complained to senior officials at his institution.

Last June, a scholarly-services firm called Cabell's International in Beaumont, Texas, launched a pay-to-view blacklist of journals it deems 'deceptive', listing criteria for deciding whether titles should be added. Kathleen Berryman, a project manager at the firm, says that a lack of clear explanations for why journals are on the anonymously maintained blacklists is a problem. Ideally, every entry on the list would state reasons for its inclusion, agrees the anonymous site manager. "I'm not sure if I will ever have time to do that myself," they say.

Berryman says that around 200 institutions have subscribed to Cabell's blacklist since its launch. The list contains about 8,000 journals, including some that aren't open access. (The firm also maintains a whitelist; some journals aren't on either list, Berryman says.)

Rick Anderson, an associate dean in the library at the University of Utah in Salt Lake City, says that the scholarly community does need a good list of predatory publishers (Anderson did paid consulting work for Cabell's when it was planning its blacklist). But it should include clear criteria and justifications for inclusion, explanations for removed entries and an appeal system, he says. "To do it well is going to be expensive and difficult." ■

PEOPLE

# World's scientists pay tribute to Stephen Hawking

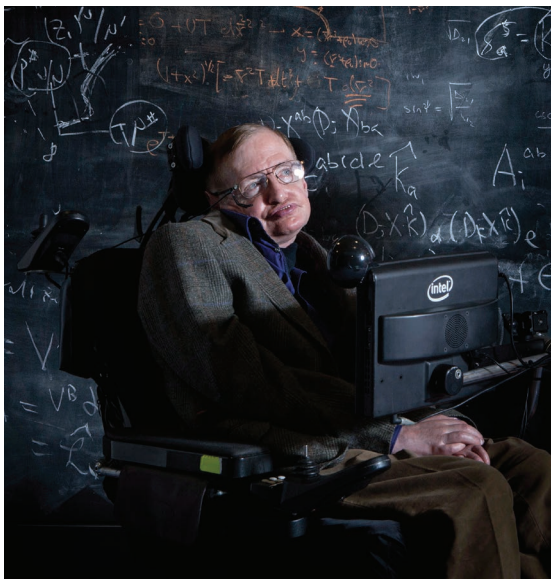
*The physicist and science icon died at his home in Cambridge, UK, aged 76.*

BY DAVIDE CASTELVECCHI

Stephen Hawking, one of the most influential physicists of the twentieth century and perhaps the most celebrated icon of contemporary science, died on 14 March at the age of 76.

Since his early twenties, Hawking had lived with amyotrophic lateral sclerosis (ALS), a disease in which motor neurons die, leaving the brain incapable of controlling muscles. His health had reportedly been deteriorating.

Hawking's death was marked by tributes from scientists worldwide. "The reaction among physicists is just profound shock and sadness," says Malcolm Perry, a theoretical physicist at the University of Cambridge, UK, and a student of Hawking's in the early 1970s. "He was a truly extraordinary man," says Roger Penrose, a theoretical physicist at the University of Oxford, UK, who in 1970 co-authored a seminal paper with Hawking on black holes.



TOM PILSTON/PANOS

Stephen Hawking, giant of cosmology, in 2013.

Another former student, theoretical physicist Raphael Bousso at the University of California, Berkeley, told *Nature* that his teacher was a brilliant physicist who also excelled at communicating science to the public. "Stephen was a joyful and light-hearted person, not to be burdened by excessively respectful and convoluted interactions," he says.

The British physicist was born in Oxford in 1942. He was diagnosed with ALS when he was 21, while a doctoral student in cosmology at the University of Cambridge. Physicians gave him just a few years to live, but his disease advanced more slowly than expected. He had an active career for decades, both as a theoretical physicist and as a popularizer of science. Hawking became one of the most recognized names in contemporary science. His books, particularly *A Brief History of Time* (1988), became blockbuster successes. He relished making cameo appearances on television shows such as *Star Trek: The Next Generation* and *The Simpsons*.

Scientifically, his name is most closely associated with the physics of black holes, which he began to study when they were considered mere mathematical curiosities in Albert Einstein's general theory of relativity. In the early 1970s, he began to investigate what quantum physics could reveal about the event horizon, a black hole's surface of no return. Hawking shocked the physics world when he calculated that this surface should slowly emit radiation (soon to become known as Hawking radiation). Black holes were not truly black.

This emission, he reasoned, should ultimately lead a black hole to shrink and disappear (S. W. Hawking *Nature* **248,** 30–31; 1974). Even more shocking to researchers was Hawking's realization in 1976 that Hawking radiation should erase information from the Universe, in apparent contradiction to some of the basic tenets of quantum theory (S. W. Hawking *Phys. Rev. D* **14,** 2460–2473; 1976). "The importance of this work was not so much the effect itself, but that he was able to provide the one clear-cut physical implication that we know of which brings together the two great revolutions of twentieth-century physics, namely, general relativity and quantum mechanics," says Penrose.

Two years ago, together with Perry and Andrew Strominger at Harvard University in Cambridge, Massachusetts, Hawking began to sketch a possible way out of the black-hole information paradox. The three of them, along with Strominger's student Sasha Haco, had been working on a follow-up paper, which Perry says is in its final stages and will have Hawking's name on it.

Perhaps because most of his work was of a speculative nature and difficult to test, Hawking never won a Nobel prize. In 2016, some wondered whether he might finally win one, when Jeff Steinhauer, a physicist at the Technion–Israel Institute of Technology in Haifa, announced that he had found convincing evidence of Hawking radiation — not in an actual black hole, but in a laboratory analogue made of ultra-cold atoms. However, some experts still consider those results inconclusive.

A more direct test of some of Hawking's findings might yet come from the study of ▶