influences cannot reproduce the predictions of quantum mechanics. Similarly, the theorem proposed by Barrett and his colleagues shows that theories that treat the wavefunction in terms of lack of knowledge of a system's physical state will also fail to reproduce those predictions. Given how well-confirmed quantum mechanics is, the theorem suggests that such epistemic theories are wrong. "I hope this will take its place alongside Bell's theorem," says Barrett.

GROUNDED IN REALITY

If the wavefunction simply reflects the experimenter's uncertainty, then different wavefunctions could represent the same underlying reality, says Terry Rudolph, an author on the paper and a physicist at Imperial College London. Rudolph gives the example of a die that can be prepared to give either even numbers, with a 1/3 probability of getting 2, 4 or 6; or prime numbers, with a 1/3 probability of getting 2, 3 or 5. The real state 2 can be produced by either preparation method, so the same reality underlies two different probabilistic models. The authors show, however, that the same reality cannot underpin different quantum states.

Their theorem does, however, depend on a controversial assumption: that quantum systems have an objective underlying physical state. Christopher Fuchs, a physicist at the Perimeter Institute in Waterloo, Canada, who has been working to develop an epistemic interpretation of quantum mechanics, says that he has avoided the interpretations that the authors exclude. The wavefunction may represent the experimenter's ignorance about measurement outcomes, rather than the underlying physical reality, he says. The new theorem doesn't rule that out.

Still, Matt Leifer, a physicist at University College London who works on quantum information, says that the theorem tackles a big question in a simple and clean way. He also says that it could end up being as useful as Bell's theorem, which turned out to have applications in quantum information theory and cryptography. "Nobody has thought if it has a practical use, but I wouldn't be surprised if it did," he says.

Because it is incompatible with quantum mechanics, the theorem also raises a deeper question: could quantum mechanics be wrong? Everyone assumes that it reigns supreme, but there is always a possibility that it could be overturned. So Barrett is now working with experimentalists to check predictions that differ between the theory and the epistemic accounts it conflicts with. "We don't expect quantum mechanics would fail this test, but we should still do it," he says. ■

N. GILBERT

Children in Mwandama, Malawi, now have a better chance of living to the age of five.

GLOBAL HEALTH

Development project touts health victory

But critics question data and cost estimates from the Millennium Villages Project.

BY NATASHA GILBERT

For villagers in Mwandama, Malawi, visiting a health worker used to mean a daunting 40-kilometre round trip on foot. So the medical centre that was built in the area as part of the Millennium Villages Project (MVP) last year has improved their quality of life — and their health. Research published this week suggests that the MVP has significantly reduced infant mortality at sites across Africa.

But some researchers have questioned the methods used to quantify the benefits of the project, and demanded that the MVP release its underlying data. "The core of the problem is lack of transparency and careful, independent analysis," says Michael Clemens, a migration and development researcher at the Center for Global Development, an independent research institution in Washington DC.

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The MVP, which is spearheaded by Jeffrey Sachs, an economist at Columbia University in New York, aims to lift some of the poorest people in Africa out of poverty and improve their standard of living by boosting health and food security. It intends to help villages at 14 sites across Africa to reach the United Nations' eight Millennium Development Goals (MDGs) by 2015.

Sachs says that many aid projects see limited success because they focus on one area at a time. By contrast, the MVP tackles all the root causes of poverty at once. For example, it simultaneously provides free fertilizer and seeds, builds schools and gives business training to farmers. Funded by cash and in-kind contributions from governments, industry and aid donors, the project is growing in influence. The government of Cameroon is planning to start a similar scheme, for example, using funding from Japan and the UN to boost economic and employment opportunities for 50,000 villagers.

Research published in *The Lancet* (P. Pronyk

et al. Lancet http://dx.doi.org/10.1016/s0140-6736(12)60207-4; 2012) now offers quantitative evidence of the success of the MVP model at nine Millennium Village sites in sub-Saharan Africa, including Mwandama (see 'Health targets'). Between 2006 and 2009, mortality in under-fives fell by an average of 22%, reaching a level roughly two-thirds of that in control villages not involved with the project, where child mortality seemed to rise.

In rural areas nationwide, under-five death rates fell by an average of 2.6% each year over the course of a decade — a stark contrast with the Millennium Villages' average of 7.8% for each year of the study. "The consistency with which child deaths went down and the size of the drop was surprising," says Paul Pronyk, director of monitoring and evaluation for the MVP at Columbia, and lead author of the paper.

But Clemens says that these headline figures are misleading for a number of reasons. He points out that the control-village data include retrospectively estimated figures that are probably too high. And nationwide improvements in child mortality over the three years of the study were almost as good as in the Millennium Villages, he says, so it is unfair to compare the project's success with a more gradual decadal trend. Furthermore, deriving trends from children monitored in a few villages for just three years introduces significant statistical uncertainty, he argues.

Using figures in the paper, Clemens calculates that the study authors can be confident only that the annual rate of decline for child mortality in the Millennium Villages lies between 1.4% and 14.3%. "If you claim to triple rates of decline you must have the evidence to back this up," he says.

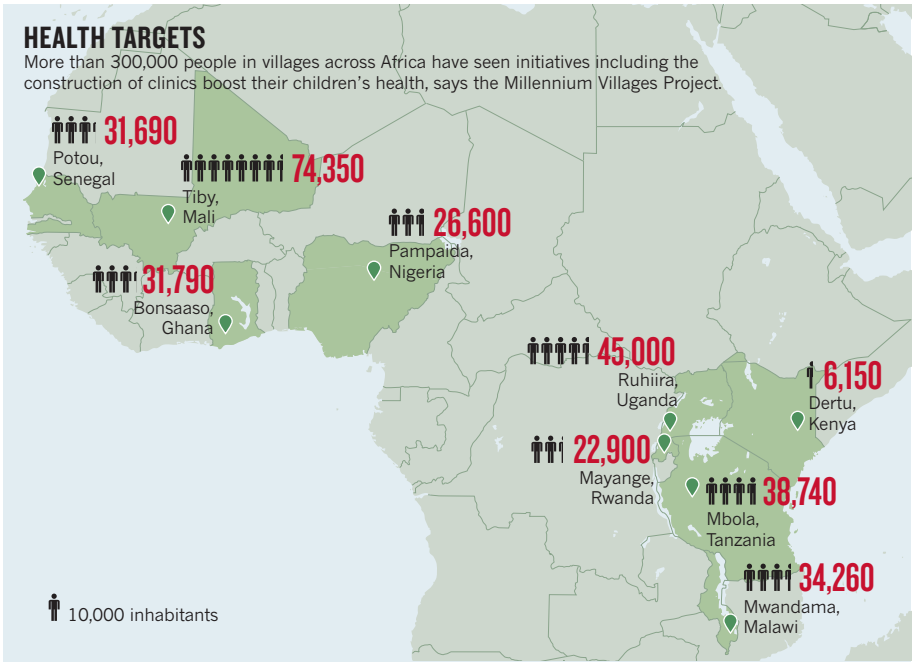
Clemens calls on the MVP to make its raw survey data available for independent scrutiny. He also questions the MVP's stated cost of US$120 per person per year, saying that it is an underestimate because it neglects indirect costs, such as the services of nearby non-governmental organizations.

Pronyk says that the mortality rates are meant to be "illustrative" of general improvement in child health, and he stands by the estimated budget. The MVP makes raw data available when requested by journals, and shares them with external partners, he adds. A Millennium Village scheme starting up in Ghana will be evaluated by independent researchers on behalf of the UK government's Department for International Development, which may help to settle the debate.

Some development experts query how widely the Millennium Village concept can be applied. Stephen Carr, an agriculture and development consultant in Zomba, Malawi, says that schools in the Millennium Villages currently attract the best teachers in the country, boosting children's educational attainment. If such projects become more widespread, they will not have the resources to reach such great heights, he warns.

Pedro Sanchez, an agricultural scientist and co-director of the MVP at Columbia, argues that "scaling up is the business of governments". His project's goal is to establish proof of concept and demonstrate that villages can achieve the MDGs with appropriate resources.

Boosting opportunities in even one school is better than in none at all, adds Andrew Daudi, team leader and science coordinator for the MVP in Mwandama, who is optimistic about the children being educated at the new primary school there. "Some of the children here are the best in Malawi," he says. "The children we educate today will be able to take over the country later." ■ SEE EDITORIAL P.147



SOURCE: P. PRONYK *ET AL.*