nature

View all journals | Search | Login

content | About | Publish | Sign up for alerts | RSS feed

Published: 17 August 2017

China’s embrace of embryo selection raises thorny questions

David Cyranoski

Nature **548**, 272–274 (2017)

196 Accesses | **8** Citations | **516** Altmetric | Metrics

A Correction to this article was published on 24 August 2017

This article has been updated

Fertility centres are making a massive push to increase preimplantation genetic diagnosis in a bid to eradicate certain diseases.

Victor Fraile/Corbis/Getty

Chinese clinics are pioneering new methods for embryo testing. Credit: Andy Wong/AP/REX/Shutterstock

Getting time with Qiao Jie is not easy. At 7:30 a.m., the line coming out of the fertility centre that she runs blocks the doorway and extends some 80 metres down the street. Inside, about 50 physicians on her team are discussing recent findings, but Qiao, a fertility specialist and president of Peking University Third Hospital in Beijing, is still in an early-morning consult.

When she finally emerges, she jumps to the topic at hand: spreading awareness of preimplantation genetic diagnosis (PGD), a procedure that helps couples undergoing *in vitro* fertilization (IVF) to avoid passing on genetic mutations that could cause disease or disability in their children. Qiao typically refuses interview requests, but she’s concerned that people aren’t getting the message about PGD fast enough. “Now, more and more diseases can be stopped — if not immediately, in the generation after next,” she says.

Early experiments are beginning to show how genome-editing technologies such as CRISPR might one day fix disease-causing mutations before embryos are implanted. But refining the techniques and getting regulatory approval will take years. PGD has already helped thousands of couples. And whereas the expansion of PGD around the world has generally been slow, in China, it is starting to explode.

The conditions there are ripe: genetic diseases carry heavy stigma, people with disabilities get very little support and religious and ethical push-back against PGD is almost non-existent. China has also lifted some restrictions on family size and seen a subsequent rise in fertility treatments among older couples. Genetic screening during pregnancy for chromosomal abnormalities linked to maternal age has taken off throughout the country, and many see this as a precursor to wider adoption of PGD.

Although Chinese fertility doctors were late to the game in adopting the procedure, they have been pursuing a more aggressive, comprehensive and systematic path towards its use there than

anywhere else. The country’s central government, known for its long-term thinking, has over the past decade stepped up efforts to bring high-quality health care to the people, and its current 5-year plan has made reproductive medicine, including PGD, a priority, an effort that Qiao is leading. Researchers are hunting down various mutations in the Chinese population that might be screened for in PGD. And well-equipped and powerful clinical-research groups, including Qiao’s, are stepping up efforts to improve the technology, increase awareness and bring down costs.

LISTEN 0:00 / 0:00

Why is preimplantation genetic diagnosis is taking off in China?

Comprehensive figures are difficult to come by, but estimates from leading PGD providers show that China’s use of the technique already outpaces that in the United States, and it is growing up to five times faster. Qiao’s clinic alone now performs more procedures with PGD each year than all of the United Kingdom.

“Looking over the development in China over the past 10 years, they might start to think it’s possible to get rid of these diseases,” says Kangpu Xu, a Chinese-born reproductive biologist at Weill Cornell Medical College in New York City.

Such systematic efforts raise thorny questions for bioethicists. Some worry that pushes to eliminate disabilities devalue the lives of those who already have them. The cost and accessibility of the procedure raises concerns about genetic traits further widening the divide between rich and poor people. Then there are concerns about the push to select for non-disease-related traits, such as intelligence or athletic ability. The ever-present spectre of eugenics lurks in the shadows. But in China, although these concerns are considered, most thoughts are focused on the benefits of the

procedures. “There are ethical problems, but if you bring an end to the disease, I think it’s good for society,” says Qiao.

Heyday for PGD

Physicians in the United Kingdom pioneered PGD in humans about 30 years ago, initially to help genetic carriers of a disorder that affects mainly boys. Thanks to the procedure, the parents were able to select for girls. Generally, the process involves removing one or a few cells from an embryo created during IVF and then using various techniques to test the structure and number of chromosomes and even the sequence of individual genes. Physicians typically discard embryos that don’t pass the tests.

Uncertain about the procedure’s safety, and wary of its potential for abuse (selecting for males in China is illegal, for example), the Chinese government restricted the practice to hospitals with a licence. By the end of 2004, only four centres in the entire country had such a licence. By 2016, the number had risen to 40.

The clinics are huge and growing. Qiao’s centre carried out 18,000 IVF procedures in 2016. The biggest clinic, the Reproductive and Genetic Hospital CITIC-Xiangya in Changsha, recorded 41,000 IVF procedures in the same year. That’s roughly one-quarter of the annual number for the entire United States. One reason for the dramatic rise is China’s policy change last year that now allows families to have two children. This has led to a huge number of older women seeking fertility treatment. Another factor is the changing culture in China. Ten years ago, people who couldn’t conceive would take traditional Chinese medicine, or they might adopt a child. “Now they know assisted reproductive technologies can help,” says Qiao.

And the centres with licences to do PGD have created a buzz in their race to claim firsts with the technology. In 2015, CITIC-Xiangya boasted China’s first “cancer-free baby”. The boy’s parents had terminated a prior pregnancy after genetic testing showed the presence of retinoblastoma, a cancer that forms in the eyes during early development and often leads to blindness. In their next try, the couple used PGD to ensure that the gene variant that causes retinoblastoma wasn’t present. Other groups have helped couples to avoid passing on a slew of conditions: short-rib-polydactyly syndrome, Brittle-bone disease, Huntington’s disease, polycystic kidney disease and deafness, among others. Qiao, working with biochemist Sunney Xie at Harvard University in Cambridge, Massachusetts, has also introduced a method that can do both chromosomal analyses and next-generation genetic analyses on a single cell. China might have got a slow start, but it is now overtaking Western nations in its use of PGD.

Qiao’s clinic screened embryos for individual disease-causing genes about 100 times last year. It screened for abnormal chromosome counts, such as that associated with Down’s syndrome, in another 670 cases. For comparison, 578 such procedures were done in the entire United Kingdom in 2014, the latest year for which numbers are available. And China’s uptake is growing fast. At CITIC-Xiangya, the number of preimplantation testing procedures rose by 277% over just 2 years, from 876 in 2014 to 2,429 in 2016, and 700 of these were for single-gene disorders.

What’s more, many fertility centres in China have the capacity for high-quality research. Qiao is interested in safety and is studying whether extracting the cells for PGD causes subtle damage to the embryo. She is in the middle of compiling data from all IVF clinics in China for a 10-year study on such effects.

Qiao is also working with Xie and Sijia Lu, the chief technology officer of Shanghai-based Yikon Genomics, to develop a technique to do all the necessary sequencing without removing cells, by sampling free-floating DNA in the media the embryos are cultured in. Such an advance could make PGD safer and easier to do.

Joe Leigh Simpson, a medical geneticist at Florida International University in Miami, and former president of the Preimplantation Genetic Diagnosis International Society, is impressed by the quality and size of the Chinese fertility clinics. They “are superb and have gigantic units. They came out of nowhere in just 2 or 3 years,” he says.

Chinese researchers are also looking for more disease-associated gene variants, specifically to expand the impact of PGD. The most concentrated efforts are being orchestrated by He Lin, a geneticist at Shanghai Jiao Tong University. He has set out an ambitious project: to pin down all the mutations in all the genes that cause diseases and put them into a single database. “We just do them one by one until we get the whole set,” he says, referring to the roughly 6,000 known genetic diseases. As disease–gene links are verified, they could be added to the list of things that PGD can screen for.

The first target, He says, is deafness. Wang Qiuju, a hearing-loss specialist at the Chinese PLA General Hospital in Beijing and head of the project, says that she plans to get up to 200,000 samples from 150 hospitals throughout China to identify associated mutations.

The large numbers are needed because there are a handful of genes involved in hearing loss, and each of them have dozens, even hundreds, of mutations. “When we have big databases, we can see the contribution of each gene more clearly. Then it’s easy to do PGD,” says Wang.

Culture clash

Such efforts, for hearing loss in particular, can seem jarring because many people in the West do not consider it a problem to be avoided. In the United States, some deaf couples have used PGD to select for congenital deafness, in an effort to preserve Deaf culture. Such sentiments wouldn’t

make sense to many parents in China, says Wang, because there is little support for them: “If they have a deaf child, they feel the need to have a normal child to help them take care of the deaf child.”

People in China seem more likely to feel an obligation to bear the healthiest child possible than to protect an embryo. The Chinese appetite for using genetic technology to ensure healthy births can be seen in the rapid rise of pregnancy testing for Down’s syndrome and other chromosomal abnormalities. Since Shenzhen-based BGI introduced a test for Down’s syndrome in 2013, it has sold more than 2 million kits; half of those sales were in the past year.

Although such testing has become routine in the United Kingdom and United States, many in the West won’t terminate a pregnancy just because of Down’s syndrome.

Jiani Chen, a genetic counsellor at the University of Oklahoma Health Sciences Center in Oklahoma City, says that this isn’t the case in China. “In China, if you want to abort a baby with Down’s syndrome, no one will scold you.” Since moving from her native Taiwan to Oklahoma, Chen herself says that she is no longer sure what she would do.

“ There are ethical problems, but if you bring an end to the disease, I think it’s good for society. ”

In the West, PGD still raises fears about the creation of an elite genetic class, and critics talk of a slippery slope towards eugenics, a word that elicits thoughts of Nazi Germany and racial cleansing. In China, however, PGD lacks such baggage. The Chinese word for eugenics, *yousheng*, is used explicitly as a positive in almost all conversations about PGD. *Yousheng* is about giving birth to children of better quality. Not smoking during pregnancy is also part of *yousheng*.

This is not to say that the Chinese haven’t thought about abuses of the technology. The Chinese government was worried, as were many Western governments, that PGD would be used to select physical characteristics, such as height or intelligence. The clinics licensed to do PGD can use it only to avoid serious disease or assist infertility treatments. And sex selection through PGD is off the table. Yikon’s Lu says that some families ask to weed out the mutation that renders many Asians unable to process alcohol, something that could affect the ability to take part in the often alcohol-fuelled Chinese business lunches. “They want their son to be able to drink,” says Lu. “We say no.” Shanghai Jiao Tong University’s He has made training genetic counsellors — people versed in the risks, benefits and ethical issues related to PGD — a priority. Currently, they are almost non-existent in China.

The UK Human Fertilisation & Embryology Authority also tightly regulates PGD — limiting its use to 400 conditions. But in the United States, clinics have fairly free rein. Sex selection, for example, is acknowledged as controversial by the American Society for Reproductive Medicine, but its ethics committee largely leaves it to individual clinics to decide what is permissible.

To many fertility specialists, what’s most striking about China’s adoption of PGD is the speed and organization of its uptake. China already seems to provide more procedures than the United States, and with growth estimated at 60–70% per year, is on target to catch up in per capita terms in the next few years.

This could be a boon for the country, given the economic arguments for PGD. For instance, one study has compared the average costs of the PGD procedure needed to avoid cystic fibrosis — US$57,500 — with the medical costs incurred in a lifetime by an average patient, which amounted to $2.3 million (I. Tur-Kaspa *et al. Reprod. Biomed. Online* **21,** 186–195; 2010). The authors calculated net savings on health care of all patients born in a year over the average patient’s lifespan of 37 years to be $33.3 billion. That is just for one of hundreds of diseases that can be avoided with PGD.

But PGD has not been an easy sell in the West. The Catholic Church, for example, opposes embryo manipulation, including the removal of cells for testing, as well as the destruction of embryos. “The idea that scientists are playing god is always a theme,” says Natasha Bonhomme, chief strategy officer at Genetic Alliance, a lobbying group in Washington DC that focuses on genetic diseases.

There are also social and economic concerns. Some parents of affected children argue that reducing the number of children with those diseases would reduce government funding for research into treatments. Others object to the idea that they are being discouraged from conceiving children the usual way.

The debate has made physicians and scientists wary. “The scientific community is not interested in getting too forward out in front of public opinion,” says Simpson, even though he thinks that the evidence is on the side of employing more PGD. “With every reproductive-biology advance,” he says, “we get the same questions: ‘won’t there be a slippery slope that leads to abuse?’ But it never happens.”

The upshot is that there has never really been advocacy organized around PGD in the United States, says Bonhomme. And without government support, it remains for many a prohibitively expensive procedure. Insurance coverage is “pitiful”, says Svetlana Rechitsky, director of the genetic-testing firm Reproductive Genetic Innovations in Northbrook, Illinois. Sitting at her desk, sorting through letters from insurers — mostly refusals to offer coverage for PGD — she says, “It’s getting worse and worse.”

Already the procedure is much cheaper in China — about one-third of what it costs in the United States. Cheaper tests will make it more palatable for national insurance coverage, something Qiao

has already started pushing for. “Before I retire, I want to get the government involved. I have 12 years,” she says.

Change history

- **18 August 2017**

  The photo originally leading this story depicted infants in a hospital in Hong Kong, which was not relevant to the subject matter. It has therefore been deleted.

Related links

Related links in Nature Research

CRISPR fixes disease gene in viable human embryos 2017-Aug-02

Secrets of life in a spoonful of blood 2017-Feb-07

Should you edit your children’s genes? 2016-Feb-23

Reproductive medicine: The power of three 2014-May-21

Making babies: the next 30 years 2008-Jul-16

Related external links

Rights and permissions

Reprints and Permissions

About this article

Cite this article

Cyranoski, D. China’s embrace of embryo selection raises thorny questions. *Nature* **548,** 272–274 (2017). https://doi.org/10.1038/548272a

Published 17 August 2017 **Issue Date** 17 August 2017 **DOI** https://doi.org/10.1038/548272a

Share this article

Anyone you share the following link with will be able to read this content:

Get shareable link

Provided by the Springer Nature SharedIt content-sharing initiative

Subjects Developmental biology • Genetics • Genomics • Health care

Further reading

- **Changing Fertility Landscapes: Exploring the Reproductive Routes and Choices of Fertility Patients from China for Assisted Reproduction in Russia**
  Christina Weis

Asian Bioethics Review (2021)

- **Is selecting better than modifying? An investigation of arguments against germline gene editing as compared to preimplantation genetic diagnosis**
  Alix Lenia v. Hammerstein, Matthias Eggel & Nikola Biller-Andorno

  BMC Medical Ethics (2019)

- **Better beings?**
  Amber Dance

  Nature Biotechnology (2017)

- **Query the merits of embryo editing for reproductive research now**
  Insoo Hyun & Catherine Osborn

  Nature Biotechnology (2017)

Nature (*Nature*) ISSN 1476-4687 (online) ISSN 0028-0836 (print)

© 2021 Springer Nature Limited