

counselling about the possible consequences of their carrier status or to abortion clinics if needed”.

Science targeted the monogenetic diseases first because they could be tackled through current knowledge. The holy grail, however, is to understand the complex noncommunicable diseases — cardiovascular disease, hypertension, diabetes, cancer, mental illness — that affect all of humanity.

Morton, an expert in the genetics of complex diseases, says hundreds of genes are associated with each of these classes of disease, each gene having, perhaps, a small effect. Moreover, extragenetic factors, from diet to pollution to lack of exercise, affect regulation of the genes.

Laboratories around the world are focusing on the complex diseases. Take type 2 diabetes in the general population (as distinct from specific families), which affects adults in both developed and developing countries. To date scientists are not absolutely sure of even a single causative gene (although one gene, called Colpain 10, is a possible contributing cause of type 2 diabetes

among Mexican Americans). About a dozen locations on the human genome, however, have been identified where the DNA sequences of people with diabetes are different from those of someone without diabetes. Work to match those sequences with the human genome and to investigate whether the sites are in a region that includes genes or gene sequences regulating gene expression is now under way. The human sequence data are speeding up the process, says Dr Don Bowden, professor of biochemistry and medicine in the human genetic unit at Wake Forest University, North Carolina, USA, but it is hard to say when this work will result in either a therapy or a diagnostic kit.

For the infectious diseases there is an added hurdle: it is not just the human genome that must be understood, but also the genome of the infectious agent and, for malaria and other vector-borne diseases, of the vector. “When we have the complete sequence of the malaria parasite,” says Chauhan, “we might compare it with the human genome to find genes that are not

present in humans, and then develop a drug that kills the parasite but does not affect the human host.”

And then, of course, there are the many ethical considerations that this new technology raises. Among them are questions like: Who is to decide if and when genome data should be used to “enhance” genomes that are basically healthy (a critical question, since such re-engineered genomes could affect future generations)?

The debate on such issues has started. Whatever its outcome, though, “in 20 years time,” says Morton, “the sequence data will be central to every branch of medical science.” And as US scientist and Nobel laureate Dr David Baltimore of the California Institute of Technology wrote in *Nature*'s special genome issue (15 February 2001), “Although I've seen a lot of exciting biology emerge over the past 40 years ... chills still ran down my spine when I first read the paper that describes the outline of our genome.” ■

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## Measles eradication still a long way off

Until recently, many people assumed that once polio had been eradicated, measles would be next in line. Now there are doubts about whether measles could — or even should — be a target for global eradication.

Five years ago, an international meeting of experts sponsored by the US Centers for Disease Control and Prevention, the Pan American Health Organization, and WHO, recommended that the World Health Assembly should consider setting a target for the global eradication of measles some time between 2005 and 2010.

That target date has never been set. Why not?

Not because the disease no longer constitutes a major public health burden. With an annual toll of some 30 million cases and 900 000 deaths, mostly in children, it still does. Measles in fact kills more than half of the 1.6 million children who die annually from vaccine-preventable diseases. And among those who survive measles, up to 10% may suffer disabilities, such as blindness, deafness, and irreversible brain damage.

Nor is it because measles fails to meet the technical criteria for eradication. It does. Humans constitute the only natural reservoir for the causative virus and there are no healthy carriers of the virus (as there are for viral hepatitis, for example). Also, an effective vaccine has been available for over three

decades and today costs only US\$ 0.26 for a single dose, including safe injection equipment. And finally, natural immunity to the virus is of lifelong duration.

There is also evidence that interrupting transmission of the virus is possible in large areas of the world — a necessary preliminary to eradication. Several regions — foremost among them the Americas — have shown that it is operationally feasible to interrupt transmission of the disease. Transmission of measles virus has almost ceased in the Americas, where it is now believed to be confined to the Dominican Republic and Haiti. Two other WHO regions — the European and Eastern Mediterranean regions — have set targets to eliminate the disease by 2007 and 2010, respectively.

Even in sub-Saharan Africa, where transmission of the virus is intensive and where over half the world's measles cases occur, a handful of countries have made remarkable progress in reducing the number of measles cases and deaths. In six southern African countries, mass vaccination campaigns during 1996–98 reduced reported measles deaths from over 300 in 1996 to only two between January 1999 and September 2000. In Malawi — one of the world's poorest countries — the number of measles cases plummeted from 7000 in 1997 to

only two in 1999. And for the first time ever there were no measles deaths.

So why is there reluctance today to make plans to eradicate the disease?

One reason is the ongoing effort to eradicate polio, scheduled for 2005 (five years later than the original deadline) and now in its, hopefully, final but most difficult stage (see WHO News story p. 582). “We have to finish polio eradication before considering measles eradication,” says Dr Ana-Maria Henao-Restrepo, medical officer and measles focal point within WHO's vaccine programme. “But in the meantime, we are working with countries throughout the world to reduce measles deaths through immunization plus, where needed, vitamin A administration. There is a lot we can do even before polio is eradicated.”

In late March this year, WHO and UNICEF issued a “global measles strategic plan” to halve measles deaths by 2005. Because measles is a highly contagious disease, the new plan calls for immunization of at least 90% of children worldwide, vs the current 74% global vaccine coverage rate. And because the initial dose of vaccine is only about 85% effective in developing countries, the plan recommends a second dose of vaccine for all children, through either routine vaccination or mass immunization campaigns. Improved surveillance and la-

boratory diagnosis are critical, the plan says, if these new targets are to be met. The plan also calls for efforts to improve the management of measles cases, including administration of vitamin A.

In 2005, a global consultation will review progress and decide whether it is technically feasible to eradicate the disease and, if so, whether there is enough political commitment to carry it through. If there is no consensus for eradication at that time, the mortality reduction targets may be stepped up instead.

Another reason for delaying a decision on measles eradication is that not enough is known about several key operational and scientific issues.

Does it, for example, make economic sense to eradicate the disease? Would it not be more cost-effective to maintain high immunization coverage and prevent measles deaths? Would countries be likely to make it a political priority? Also, unlike oral polio vaccine, the measles vaccine can only be given by injection administered by trained health workers. Can such an injectable vaccine be used safely and effectively on a global scale in mass immunization campaigns? Research is currently under way to find alternative ways of delivering the vaccine. These include aerosol delivery, the use of powder vaccines that can be inhaled, and injection by needle-free jet injectors (a multidose jet injector could be available for use within the next five years).

Questions have also been raised about whether the measles vaccine retains its efficacy in children infected with HIV and about the possibility that such children could become long-term carriers of the measles virus, thereby scuppering any chance of eradicating the disease. Research is currently under way on this hypothesis. However, experience in southern Africa, where up to 10% of newborn babies are HIV-positive, suggests that it is not a problem.

In the meantime, commitment among donors to any future measles eradication initiative hangs in the balance. Dr Edward Hoekstra, medical coordinator for measles activities at UNICEF, told the Bulletin that while there is a political consensus on the new mortality reduction targets, donor governments remain divided on the issue of measles eradication. "The problem is that in the western world most children have access to health care and people have forgotten what measles can do," he said. "In developing countries, children with measles often die from complications such as diarrhoea and pneumonia because they don't have access to treatment. The new mortality reduction targets have been established because we have an obligation to these children to act now to prevent these deaths."

All in all, it remains an open question whether measles eradication will get the green light in 2005. Much will depend on the outcome of the polio eradication initiative, on regional attempts to bring the disease

under control, and on the answers to the technical and scientific questions hanging over the decision.

For sure, while the world waits for a decision about eradication of measles, the decision to do something right now about the 2500 children dying daily from measles doesn't seem such a bad idea. ■

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#### ERRATUM

On page 415 of last month's issue (Vol. 79, No. 5), second column, line 18, "50 000 IU vitamin A" should read "**10 000** IU vitamin A"



A girl is immunized against measles by a UNICEF-assisted mobile vaccination team covering villages close to Dili, the East Timor capital, as other children stand in line waiting their turn.