Looking into the reasons for hearing loss in Nicaraguan children has occupied James Saunders, left, for a decade.

For a WEB EXTRA slide gallery of photographs from Nicaragua, see dartmed.dartmouth.edu/su09/we06.

Nicaraguan findings may lead to hearing aid

On a medical outreach trip to Nicaragua a decade ago, James Saunders, M.D., expected to see a lot of kids with ear infections—and he did. What he didn't expect to see was so many kids with hearing loss.

"We were just inundated with children with sensorineural hearing loss," recalls Saunders, an otolaryngologist who joined the DMS faculty in 2008, after several years at the University of Oklahoma. Saunders wondered how prevalent hearing loss was in Nicaragua and what had caused it. He's been trying to answer those questions ever since. So far, he's ruled out a couple of potential causes and found numerous others.

Loss: In 2004 and 2005, Saunders led teams that screened 274 children in four rural schools in the Jinotega region of Nicaragua. They found that about 18% of the children had significant but previously undetected hearing loss. In the U.S., only about 3% of children have hearing loss. Its true prevalence in Nicaragua is probably even higher, Saunders noted in a 2007 paper in *Laryngoscope*, because children with severe to profound hearing loss may not attend school. The researchers found that most children had numerous risk factors for deafness, including a family history of hearing loss, low birth weight, prematurity, neonatal distress, maternal infections during pregnancy, and/or exposure to the antibiotic gentamicin, which is known to cause hearing loss.

With so many risk factors in play, it has been tough to tease out the main culprits. So far, Saunders has eliminated two common genetic causes: a mutation in the GJB2 gene (which causes what's known as connexin 26-related deafness) and a mutation of the 12S rRNA gene (which increases susceptibility to the ototoxic effects of aminoglycocides, a family of antibiotics that includes gentamicin). The latter finding—published in *Otolaryngology – Head and Neck Surgery*—does not, however, rule out gentamicin as a major cause.

It's hard to know if the gentamicin caused the deafness in all cases.

Simple: In Nicaragua, gentamicin can often be purchased without a prescription. "This is a huge problem in the developing world," says Saunders. Gentamicin is a "really cheap, really broad-spectrum, highly effective drug," he explains, but it shouldn't be used to treat a simple illness like a sore throat, as often happens in places like Nicaragua.

In a recent study of 96 Nicaraguans with hearing loss, Saunders found that 31 had been exposed to gentamicin in the womb or as a baby or child. But since "gentamicin exposure was frequently paired with other risk factors," he says, it's hard to know if the drug caused the deafness in all cases.

In addition to considering genetics and gentamicin exposure, Saunders is also investigating the role of environmental contaminants. Pollution is severe and widespread in Nicaragua due to the use of pesticides in farming and mercury and arsenic in gold mining. Saunders was inspired to look at environmental influences in part by the work of DMS's Margaret Karagas, Ph.D., who studies how environmental contaminants contribute to disease. Saunders is going to Nicaragua again this summer and will collect water samples in Jinotega and fingernail samples in a region known as the mining triangle, which also has a high rate of hearing loss. Karagas will then analyze the samples.

Collaborators: Saunders has found other Dartmouth collaborators, too, including a recent undergraduate alumnus who is currently working in the mining region as a Fulbright Scholar—Ben Jastrzembski, DC '08. He and Saunders met last fall. "Over dinner," Saunders says, "we hatched this idea to look at hearing loss in miners," because they're exposed to such high levels of mercury and arsenic. Jastrzembski is now screening miners using a PC-based hearing test designed by another Dartmouth physician-researcher, Jay Buckey, M.D.

Saunders has also been instrumental in building a nonprofit organization that helps children with hearing loss in Jinotega.

When Saunders began his research in Nicaragua, he expected to find clear causes for the high prevalence of hearing loss. He's since adjusted his expectations. Maybe the causes are not simply genetic or environmental, he says. "Maybe . . . it's really a combination of the two." JENNIFER DURGIN