nature medicine

Injecting hope

Vaccines are the cornerstone of contemporary medicine and are considered the best approach to reduce morbidity and mortality due to infectious disease. The eradication of smallpox, the success of childhood immunization campaigns and the recent report of a 39% decrease in numbers of measles deaths worldwide all illustrate the promise of vaccination in controlling disease epidemics and preventing disease mortality. Vaccines are also touted as viable therapeutic approaches for the treatment of noninfectious diseases such as allergy, autoimmunity and cancer.

Yet while advances continue to be made (such as vaccines to prevent cervical cancer caused by human papillomavirus, protect against rotavirus infection and prevent or reduce severe malarial disease), old scourges (tuberculosis, influenza) persist, and more modern threats (SARS, HIV) continue to stymie vaccine efforts directed at eradication, treatment or control.

In 1998, *Nature Medicine* published its first supplement—also on vaccines. The accompanying editorial emphasized the need for a 'thorough understanding of biology' in view of the failure of past efforts to successfully generate efficacious vaccines. While clearly the recent advances cited above underscore the progress that has been achieved, we still have far to go. If much of the historical success of vaccine development derives in part from fortuitous discovery coupled with astute application of knowledge gained (Jenner and Pasteur are two such examples), rather than from an exhaustive knowledge of the mechanisms of immune responses, is today's vaccine development better informed? Are we limited by the pathogens we seek to eliminate and their ability to evade immunity, or by our tools, resources and thinking?

In this special supplement to *Nature Medicine*, we present a Historical Perspective chronicling the development of vaccines and a series of Reviews, Commentaries and Perspectives authored by leading experts in the fields of vaccine research and technology, manufacture and delivery, and bioethics. Additional material includes a Profile of one of the modern founders of vaccine research and a News Feature on schemes to fund and distribute vaccines.

These essays document the successes of vaccine research and consider the obstacles that continue to impede new development. The advances in biological insight are reflected in the comprehensive Review articles that detail the immunological foundation of vaccine efficacy against infectious disease—the induction of humoral and mucosal immunity—and highlight ongoing efforts to stimulate the T cell arm of adaptive immunity. The Commentaries consider the hurdles to vaccine development from ethical and practical standpoints, and the Perspectives look to the future application of vaccines for allergy and autoimmunity and the design of novel adjuvants to potentiate robust immune responses.

But enormous obstacles remain. Vaccine research is strong, but successful translation to the clinic lags far behind. At issue are concerns regarding development capability (industry involvement, infrastructure, manufacture and testing in developing nations), ethical and regulatory considerations, vaccine safety, impediments to adequate delivery (insufficient facilities, training, access to medical supplies), government commitment to both vaccine research *and* manufacture, and reliable vaccine efficacy for the target population. Insufficient funding for vaccines may supersede all of these hurdles.

In January 2005, the Bill and Melinda Gates Foundation in conjunction with Norway, pledged more than 1 billion dollars to the Global Alliance for Vaccines and Immunization (GAVI) to support programs aimed at childhood immunization. Yet estimates are that more than 8 billion dollars are required to immunize 90% of children in the poorest nations over the next ten years with currently available vaccines—estimates that notably do not account for the many diseases for which vaccines do not yet exist.

The GAVI donation brings into focus the timely issue of global vaccine preparedness. With concerns of bioterrorism and a flu vaccine shortage in the United States, along with fears of an avian flu pandemic, public awareness of the need for continued commitment to vaccine development is high, particularly in industrialized countries that have grown unaccustomed to infectious disease outbreaks due to childhood immunization programs. Increasingly recognized is the importance of the health, not simply of an individual nation, but of the global community.

In compiling this supplement we had the opportunity to track the authors electronically across the globe, as they applied their expertise to ongoing vaccination efforts in the developing world, or in their home countries as they participated in relief efforts to prevent disease outbreak following the 26 December 2004 tsunami disaster. Thus although a surfeit of obstacles remain in vaccine development and delivery, their efforts reflect a passion and a commitment to global health that will surely translate to medical successes.

We hope you find this supplement instructive and enlightening. We invite you to access its content online at http://www.nature.com/nm/supplements/, where it will be freely available for 3 months. In addition to the pieces featured here, we provide online a library of links to related articles and news items focused on vaccine development and published by the Nature Publishing Group. We are pleased to acknowledge the generous financial support of the Office of AIDS Research (National Institutes of Health, USA), of Chiron Vaccines and of Antigenics. *Nature Medicine* retains sole responsibility for editorial content and peer review.