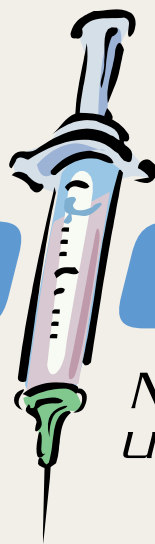


Shoot to protect

by Lisa Spellman



New vaccines under development

The world before vaccines:
Measles – 2.7 million dead.
Tetanus – 300,000 newborns and 30,000 birth mothers dead.

Smallpox – millions dead.

Avian flu – 144 deaths . . . so far.

Fortunately for humans, our ancestors figured out ways to immunize themselves against disease starting with the Chinese in the 18th century and continuing today with the development of new vaccines to counter emerging health threats.

Global immunization programs have literally eradicated smallpox from the planet, said Phil Smith, M.D., chief of infectious diseases at UNMC.

And even though they get a bad rap, the vaccines used today have a high degree of effectiveness with very few side effects, he said.

“On the whole, vaccines are extremely safe.”

Ironically, the way vaccines work is by infecting a person with the very disease it is meant to prevent. The Chinese used matter from the blisters of a person infected with smallpox to immunize uninfected people.

Today scientists make vaccines using only a small part of the virus called an antigen.

Antigens stimulate the body’s immune system to make antibodies that fight infection.

In addition to producing antibodies, the immune system also makes memory cells, Dr. Smith said, which remain in the body to fight off the same

disease should a person be re-exposed.

The effectiveness of immunizations has led to the array of recommended vaccinations that children receive today.

By age 2 most children receive an average of nine immunizations against such diseases as hepatitis A, measles, mumps and rubella.

Most people’s bodies react to the vaccination and build immunity to the disease 10 to 14 days after getting the shot, Dr. Smith said. But the immune systems of about 10 percent of the people who are vaccinated do not respond at all.

That might have been the case with the mumps outbreak in the spring of 2006 when 1,165 people in seven Midwestern states ranging from Oklahoma to Minnesota came down with the illness, according to the Centers for Disease Control and Prevention.

For the most part, vaccines used today work pretty well, Dr. Smith said.

With so many diseases easily managed by the prick of a needle, it’s no wonder people expect medicine to create another vaccine when a new disease threat appears.

Unfortunately it’s not always that simple, since some viruses mutate constantly.

Medical science has come a long way in producing vaccines that prevent viral infection.

“The avian flu could become pandemic by mutation or by exchanging genetic material with another flu virus. This genetic flexibility makes it more dangerous.”

But viruses also have been evolving with time and every now and then a new strain comes along that seems impervious to modern medicine.

The Spanish Flu Pandemic of 1918 is one such example of a strain of influenza so deadly that it killed more than 30 million people worldwide – many of whom succumbed to the virus within hours of the first signs of infection.

The speed with which some viruses mutate makes them more deadly, Dr. Smith said.

Mutation is a survival skill. However, viruses cannot live and reproduce independently, he said.

“Instead they take over a cell and hijack its reproductive system to duplicate itself, and in the process exchange genetic material with the host cell,” Dr. Smith said.

Another factor that makes some viruses more lethal is their ability to enter multiple species.

“The avian flu could become pandemic by mutation or by exchanging genetic material with another flu virus,” Dr. Smith said. “This genetic flexibility makes it more dangerous.”

It also makes it more difficult to create a vaccine that would immunize people against it.

While medical scientists struggle to find ways to vaccinate people against new strains of flu or HIV, progress has been made on other unlikely fronts.

Sam Sanderson, Ph.D., associate professor in the School of Allied Health Professions at UNMC, has found a way to vaccinate smokers against nicotine.

“The vaccine sensitizes the immune system to recognize the molecules in addictive substances as foreign and produce antibodies to attack it,” Dr. Sanderson said.

The key to this process lies in the cells that present the antigens to the immune system.

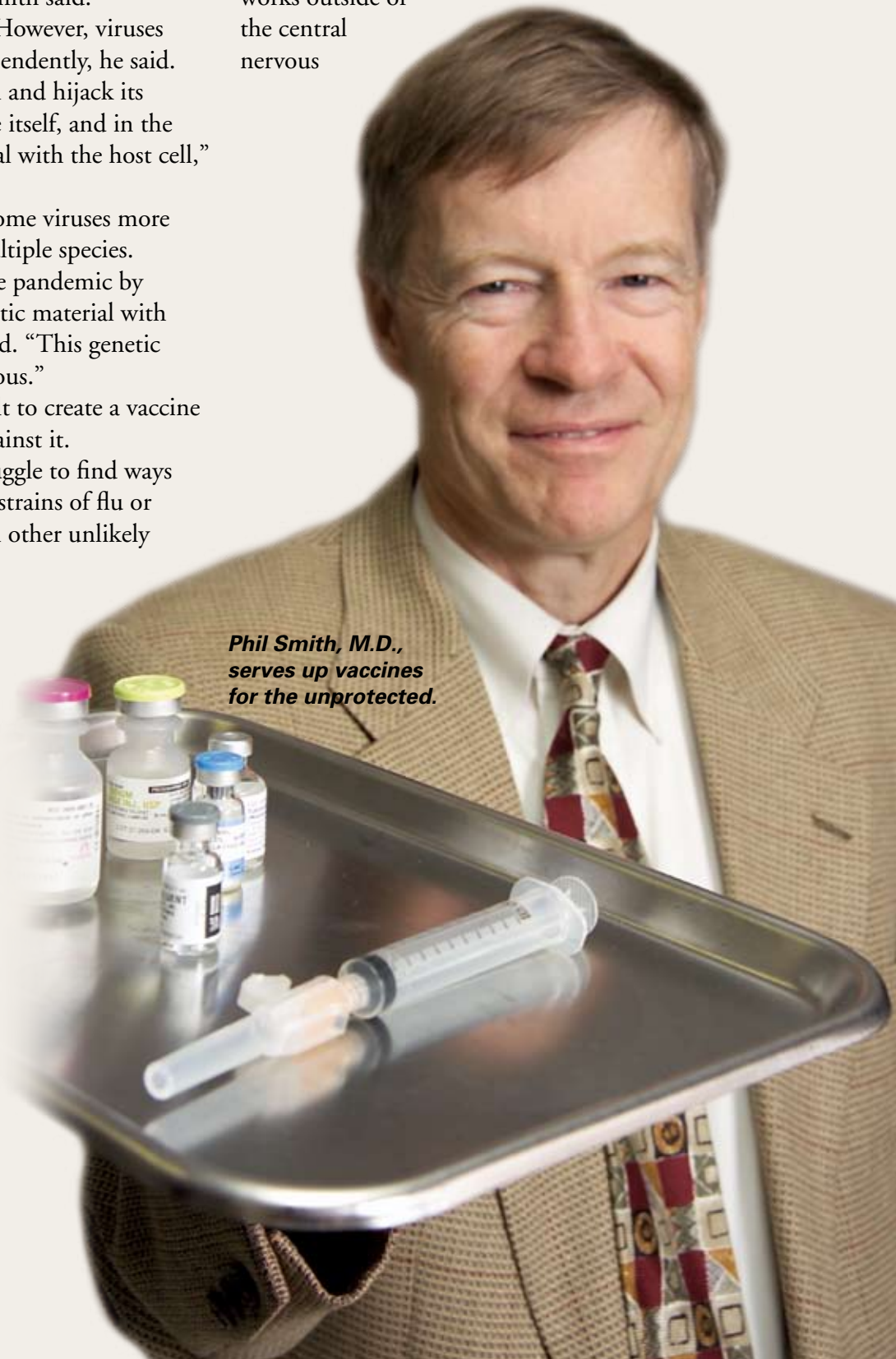
The nicotine vaccine takes advantage of this by piggybacking nicotine onto a

synthetically produced peptide engineered to seek out and bind itself to certain receptors found on those cells (also called antigen presenting cells).

Once bound to the antigen presenting cells the nicotine is internalized, processed and ready for presentation to the immune system.

“Virtually anything you need a vaccine for can be attached to the peptide,” Dr. Sanderson said.

“The best part about the nicotine vaccine is that it works outside of the central nervous



Phil Smith, M.D., serves up vaccines for the unprotected.

system, leaving the door open for other secondary treatment options.”

The nicotine vaccine has other advantages as well, he said. It can be produced in mass quantities within days; it can be freeze dried into a powder giving it a longer shelf life than traditional vaccines that require refrigeration; and it doesn't need any preservatives.

“We can purify the vaccine to 100 percent purity. No viral contamination. No bacterial contamination. When you are ready to use it, just mix it with water and you're good to go,” Dr. Sanderson said.

Dr. Sanderson and his team have worked on the nicotine vaccine for four years using mice and rats, but won't be able to test the vaccine in humans for another two years.

While he waits to begin clinical trials, Dr. Sanderson is applying this technology to another highly addictive substance – methamphetamine.

Tony Hollingsworth, Ph.D., also has discovered a novel approach to applying the principles of how vaccines work.

Dr. Hollingsworth, a professor in the Eppley Institute who studies pancreatic cancer, has found

that by using the same antigen commonly found on pancreatic cancer cells he can stimulate the immune system of mice to recognize and attack it.

“But unlike the traditional role of vaccines, which is to prevent disease, this vaccine would be used after a person is diagnosed with pancreatic cancer as part of their treatment plan,” he said.

Right now, Dr. Hollingsworth and his team are trying to determine what other drug agents to combine with the vaccine to make it more effective.

“Using the vaccine alone has proven to incrementally increase the life span of the mouse,” said Dr. Hollingsworth, who has been working on it for four years now. “But our goal is to extend that survival rate.”

Certainly without vaccines the world would be a much darker place.

Children would succumb to all sorts of diseases early in life. Infant mortality rates would skyrocket.

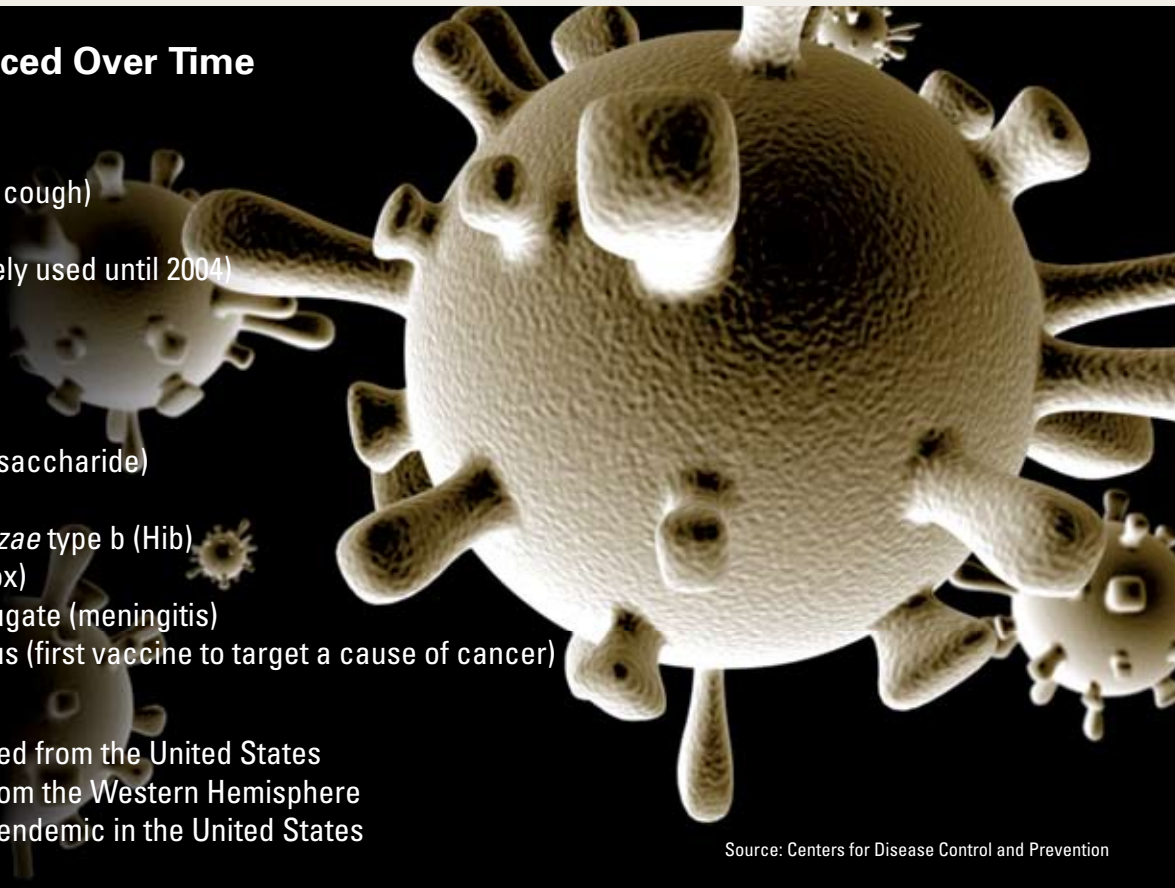
And while there are always new disease threats emerging, the amazing ability of the human immune system to fight disease combined with the ingenuity of medical science gives hope and the promise of an even brighter future. *D*

Key Vaccines Introduced Over Time

- 1796 – Smallpox
- 1923 – Diphtheria
- 1926 – Pertussis (whooping cough)
- 1927 – Tetanus
- 1945 – Influenza (not routinely used until 2004)
- 1955 – Polio
- 1963 – Measles
- 1967 – Mumps
- 1969 – Rubella
- 1977 – Pneumococcal (polysaccharide)
- 1982 – Hepatitis B
- 1985 – *Haemophilus influenzae* type b (Hib)
- 1995 – Varicella (chicken pox)
- 2000 – Pneumococcal conjugate (meningitis)
- 2006 – Human papillomavirus (first vaccine to target a cause of cancer)

Facts:

- 1977 – Smallpox is eradicated from the United States
- 1991 – Polio is eliminated from the Western Hemisphere
- 2005 – Rubella is no longer endemic in the United States



Source: Centers for Disease Control and Prevention