Practical Applications of Immunology (Ch 18)

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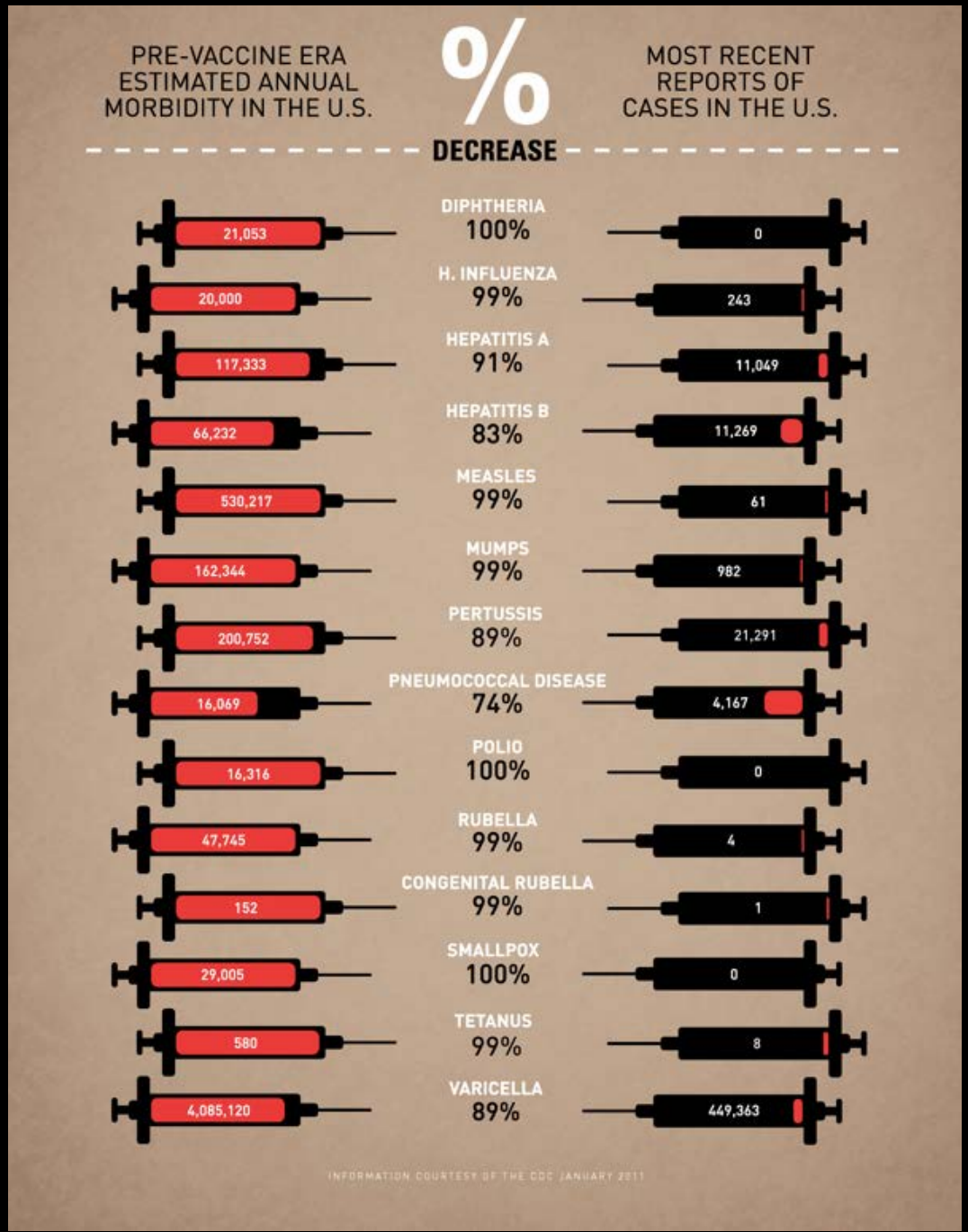
Vaccine Overview

Practical Applications of Immunology (Ch 18)



behance.net, CDC.gov

Variolation

Lady Mary Wortley Montague (1689-1762)

"Sacred to the Memory
of
the Right Honourable
Lady Mary Wortley Montague.
Who happily introduc'd from Turkey,
into this Country,
The Salutary Art
Of inoculating the Small Pox.
Convinc'd of its Efficacy
She first tried it with Success
On her own Children.
And then recommended the practice of it
To her fellow Citizens.
Thus by her Example and Advice,
We have soften'd the Virulence
And escap'd the danger of this malignant
Disease..."

1789

Measles cases in the United States, 1960–2010. (CDC, 2010)

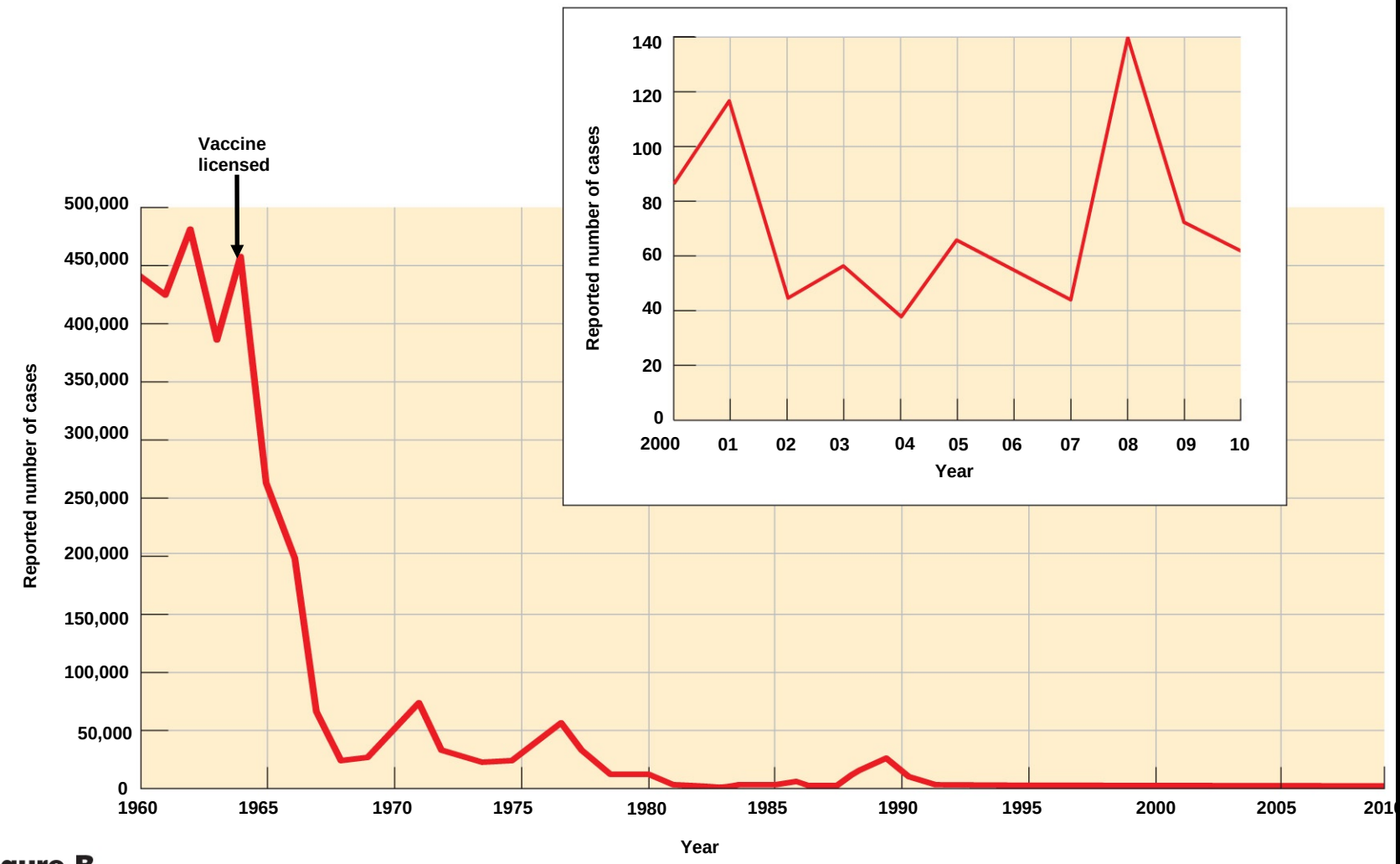


Figure B

Vaccines for bacteria

TABLE 18.1 Principal Vaccines Used in the United States to Prevent Bacterial Diseases in Humans

Disease(s)	Vaccine	Recommendation	Booster
Tetanus, diphtheria, and pertussis	DTaP (children younger than 3), Tdap (older children and adults), Td (booster for tetanus and pertussis)	DTaP (months 2, 4, 6, 15–18; years 4–6);* Td (adults every 10 years); Tdap (similar to Td; single dose for children aged 11–12 years, or adults aged 19–64); booster every 10 years	Tdap (booster) every 10 years
Meningococcal meningitis	Purified polysaccharide from *Neisseria meningitidis*	For people with substantial risk of infection Recommended for college freshmen, especially if living in dormitories	Need not established
Pneumococcal pneumonia	Purified polysaccharide from seven strains of *Streptococcus pneumoniae*	For adults with certain chronic diseases; people over 65; children 2–23 months	None if first dose administered ≥ 24 months
Haemophilus influenzae type b meningitis	Polysaccharide from *Haemophilus influenzae* type b conjugated with protein to enhance effectiveness	Children prior to school age; see Table 18.3	None recommended

* For details, see www.cdc.gov/vaccines/vdp-vac/pertussis/

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Vaccines for viruses

TABLE 18.2 Principal Vaccines Used in the United States to Prevent Viral Diseases in Humans

Disease	Vaccine	Recommendation	Booster
Influenza	Injected vaccine, inactivated virus (nasally administered vaccine with attenuated virus is now available for some)	For chronically ill, including children over 6 months. Adults over age 65. Healthy children aged 6–23 months (because higher risk of related hospitalizations). Health care workers and others in contact with high risk groups. Healthy persons aged 5–49 years can receive intranasal vaccine.	Annual
Measles	Attenuated virus	For infants aged 15 months	Adults if exposed during outbreak
Mumps	Attenuated virus	For infants aged 15 months	Adults if exposed during outbreak
Rubella	Attenuated virus	For infants aged 15 months; for women of childbearing age who are not pregnant	Adults if exposed during outbreak
Chickenpox	Attenuated virus	For infants aged 12 months	(Duration of immunity not known)
Poliomyelitis	Killed virus	For children, see Table 18.3; for adults, as risk to exposure warrants.	(Duration of immunity not known)
Rabies	Killed virus	For field biologists in contact with wildlife in endemic areas; for veterinarians; for people exposed to rabies virus by bites.	Every 2 years
Hepatitis B	Antigenic fragments of virus	For infants and children, see Table 18.3; for adults, especially health care workers, homosexual men, injecting drug users, heterosexual people with multiple partners, and household contacts of hepatitis B carriers.	Duration of protection at least
Hepatitis A	Inactivated virus	Mostly for travel to endemic areas and protecting contacts during outbreaks	Duration of protection estimated at about 10 years
Smallpox	Live vaccinia virus	Certain military and health care personnel	Duration of protection estimated
Herpes zoster	Attenuated virus	Adults over age 60	None recommended
Human papilloma virus	Antigenic fragments of virus	All females under age 26. Boys optional.	Duration at least 5 years

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Immunization Schedule

TABLE 18.3 Recommended Immunization Schedule for Persons Aged 0–6 Years—United States, 2011 (CDC)

Vaccine \ Age	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	19–23 months	2–3 years	4–6 years
Hepatitis B	HepB	HepB			HepB						
Rotavirus			Rv	Rv	Rv						
Diphtheria, Tetanus, Pertussis			DTaP	DTaP	DTaP		DTaP				DTaP
Haemophilus influenzae type b			Hib	Hib	Hib	Hib					
Pneumococcal*			PCV	PCV	PCV	PCV				PPSV	
Inactivated Poliovirus			IPV	IPV	IPV						IPV
Influenza					Influenza (Yearly)						
Measles, Mumps, Rubella						MMR					MMR
Varicella						Varicella					Varicella
Hepatitis A†						HepA (2 doses)					
Meningococcal‡										MCV	

Note: Vaccines are listed under routinely recommended ages. Bars indicate range of recommended ages for immunization. For those who fall behind or start late, see the catch-up schedule. Additional information at www.cdc.gov/vaccines/recs/schedules/

* PCV = Pneumococcal conjugate vaccine, PPSV = Pneumococcal polysaccharide vaccine.

† The two doses at least 6 mo. apart.

‡ Meningococcal conjugate vaccine (MCV) for children aged 2–10 years with defective immune systems and certain other high risk situations.

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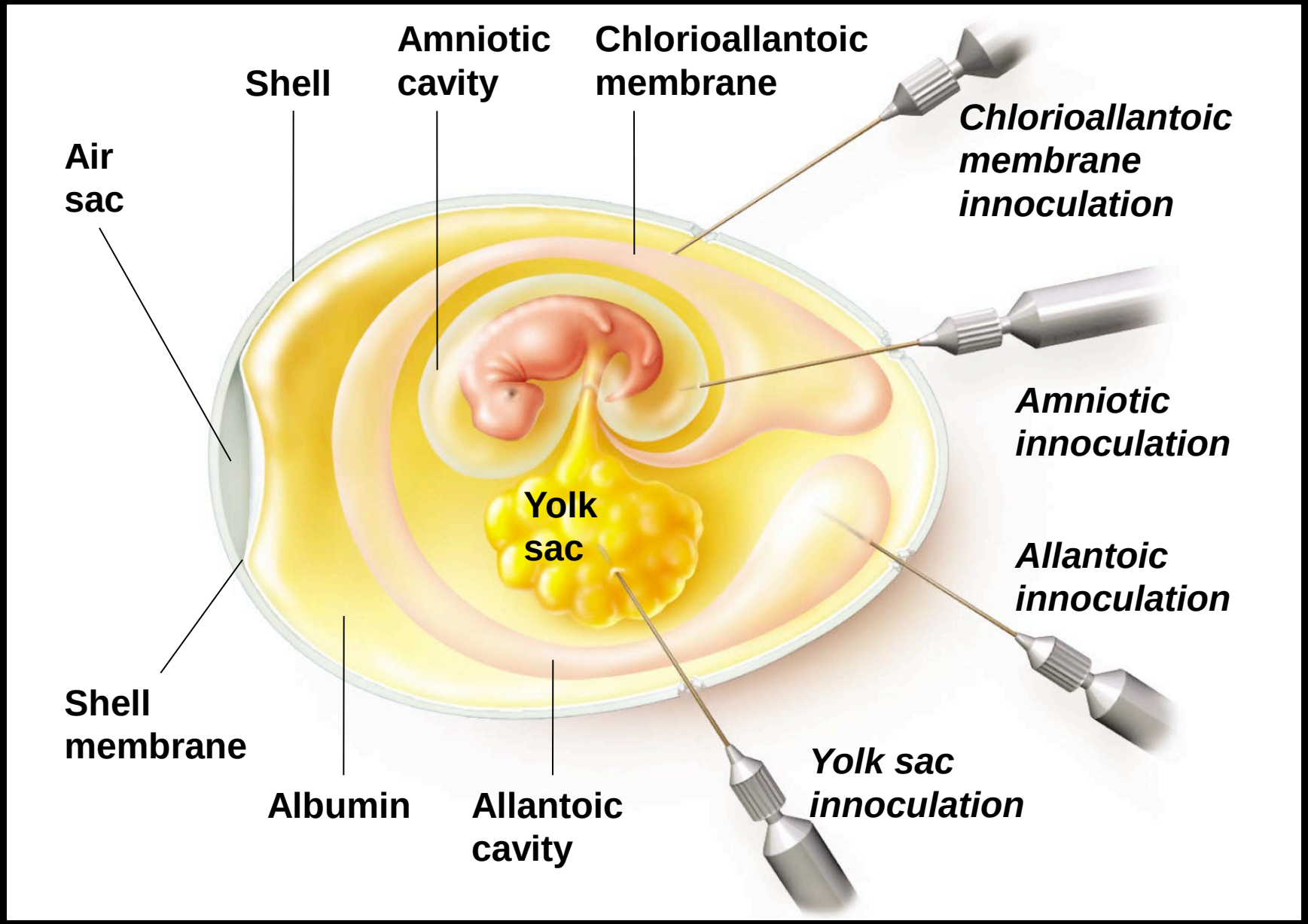
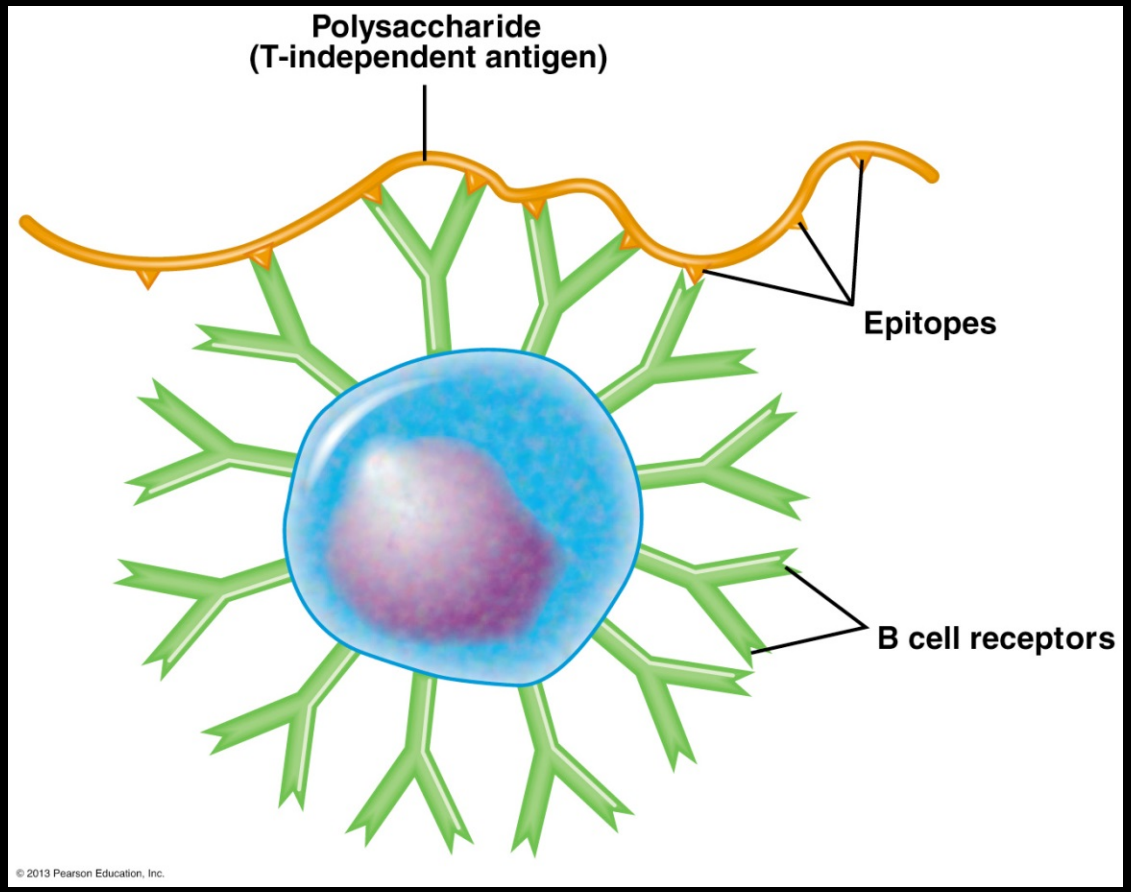
Vaccine Types

Live Attenuated: Figure 18.1 Influenza viruses are grown in embryonated eggs.

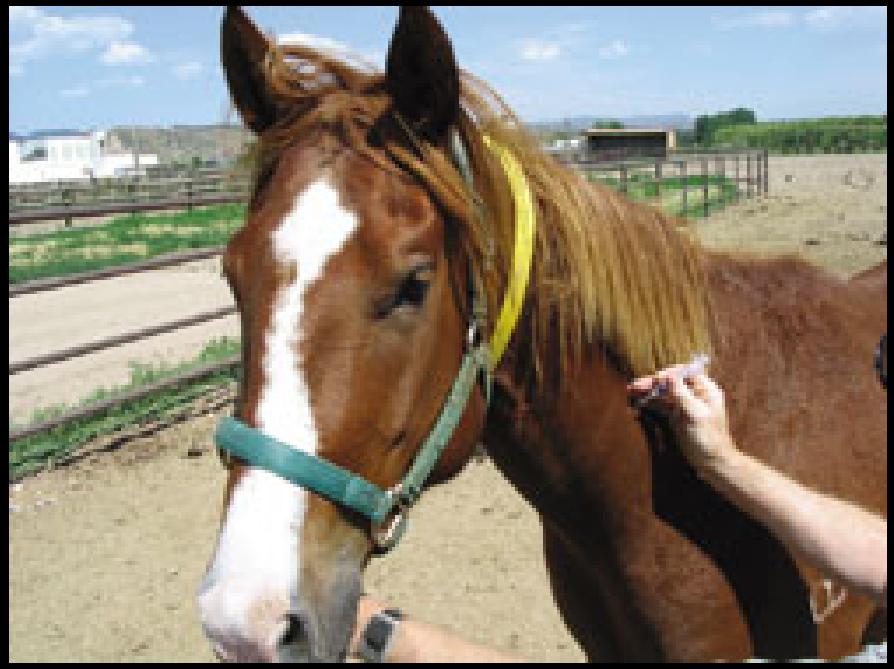
Live Attenuated: Figure 13.7 Inoculation of an embryonated egg.



Conjugated vaccines: Figure 17.6 T-independent antigen



West Nile DNA vaccine for horses



nature.com

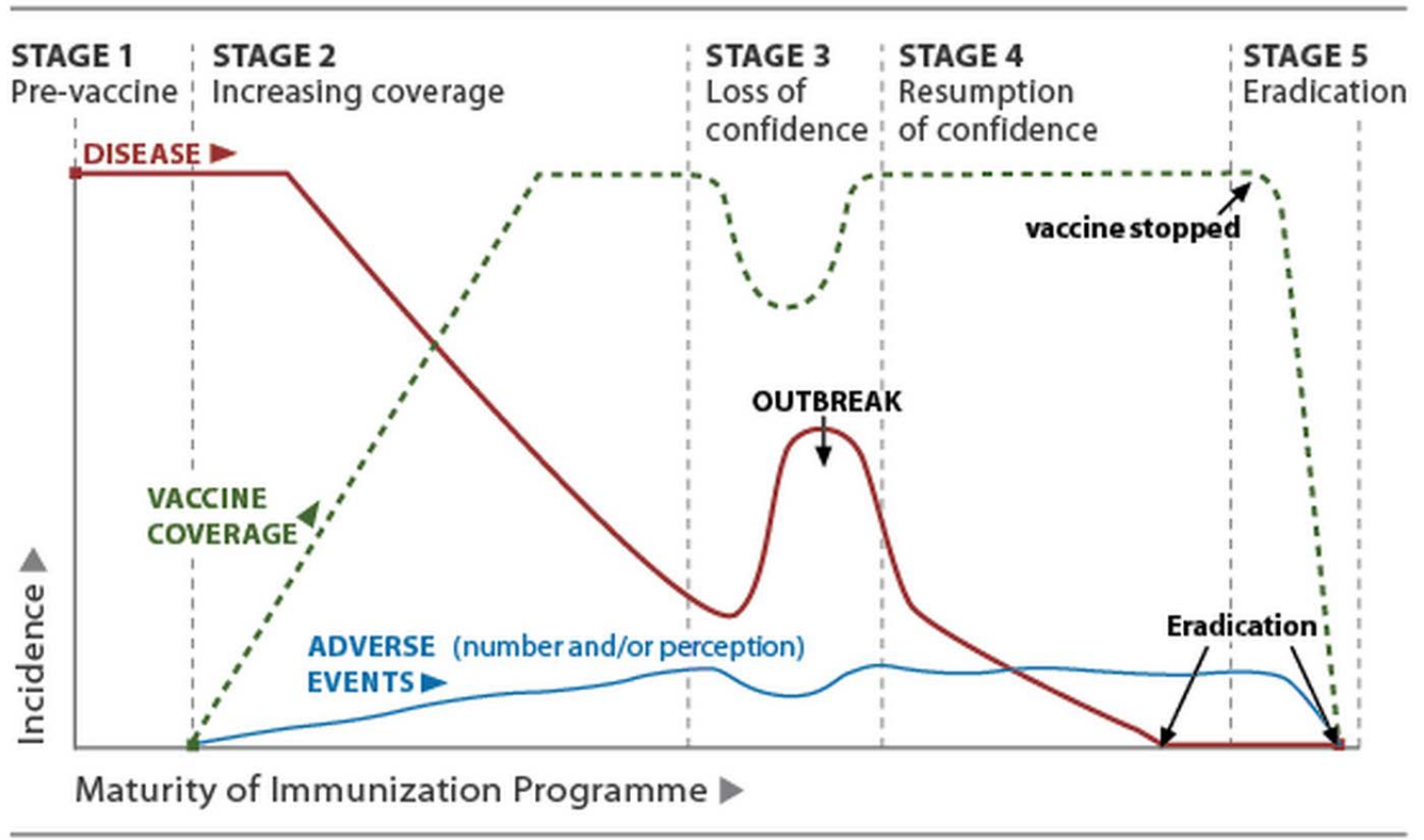
Adjuvants

Thimerosal FAQ page from CDC

http://www.cdc.gov/vaccinesafety/concerns/thimerosal/

CDC list of vaccine ingredients

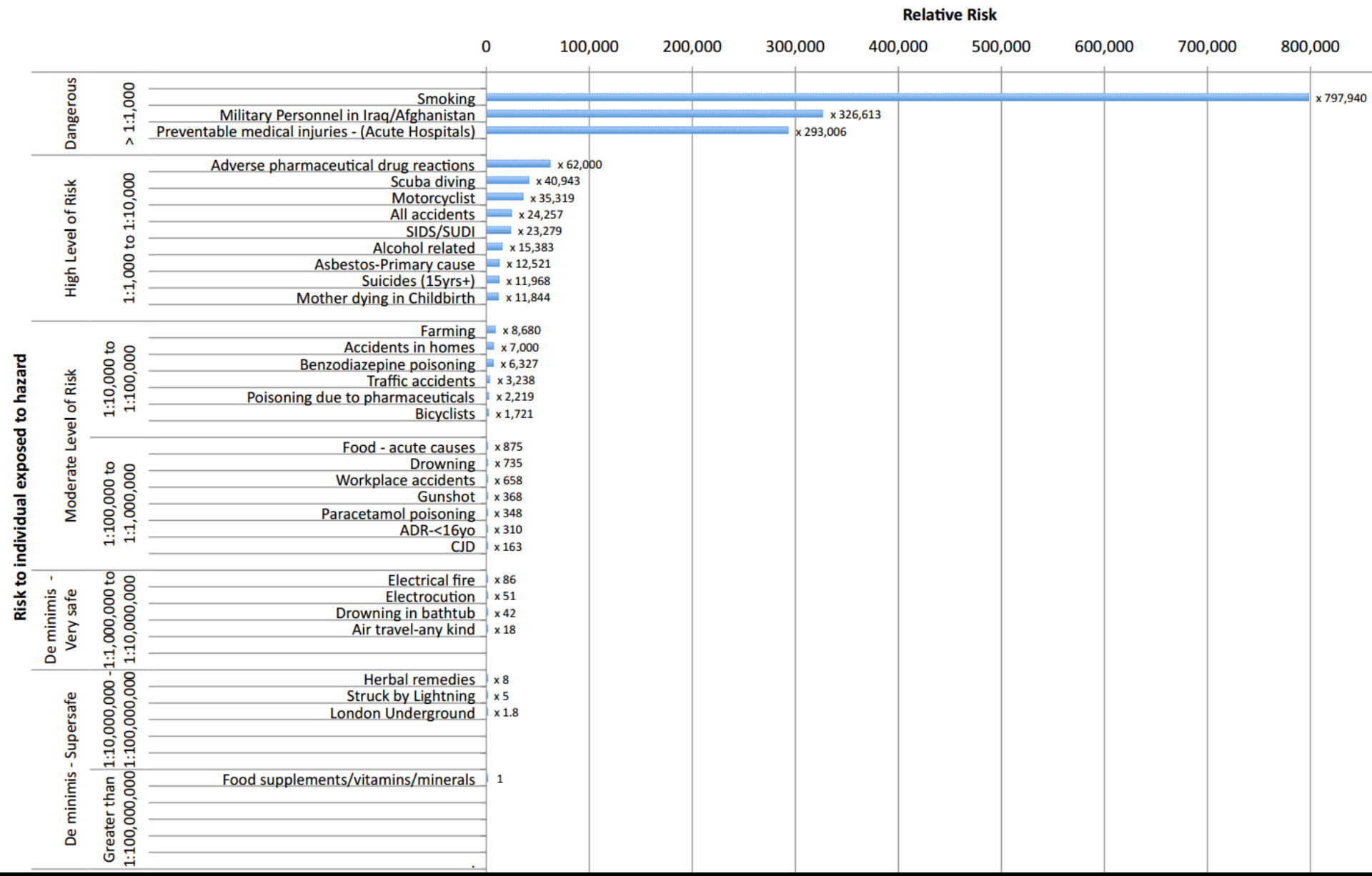
Perception of Risk



Potential stages in the evolution of an immunisation programme.

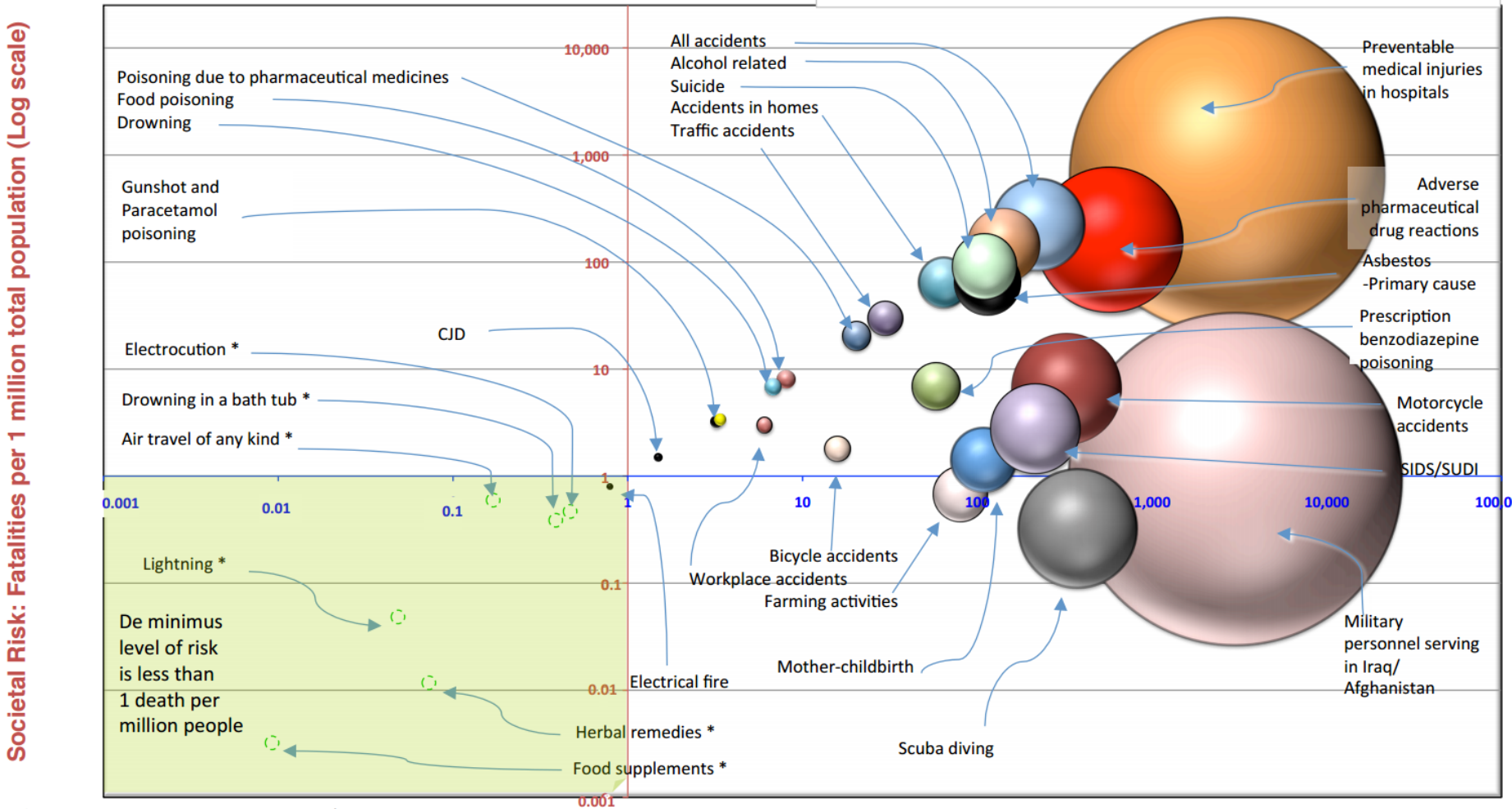
Diagram adapted from Chen RT et al. The Vaccine Adverse Event Reporting System (VAERS). Vaccine, 1994: 12(6):542–550.

Risk in United Kingdom



Societal vs Individual Risk of Death in the United Kingdom

Societal risk is represented as the risk of death per million total population. Individual risk is represented as the risk of death per million exposed to that hazard. Bubble size represents the relative risk to an individual. By way of example, the bubbles representing deaths due to preventable medical injuries in hospitals and military personnel in Iraq/ Afghanistan are a similar size because the risk of death to a patient in a UK hospital is similar to that for a soldier deployed to a war zone. Medical injury poses a greater risk to society simply because vastly more citizens are exposed to that risk and hence die. **Note: Log scales.**



* Note: Green dotted circles represent bubbles/dots too small to print

v3

Sources: Variety of UK Government and NGO databases, reports, officials and expert advisers.

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Commissioned by Alliance for Natural Health International (www.anhinternational.org)

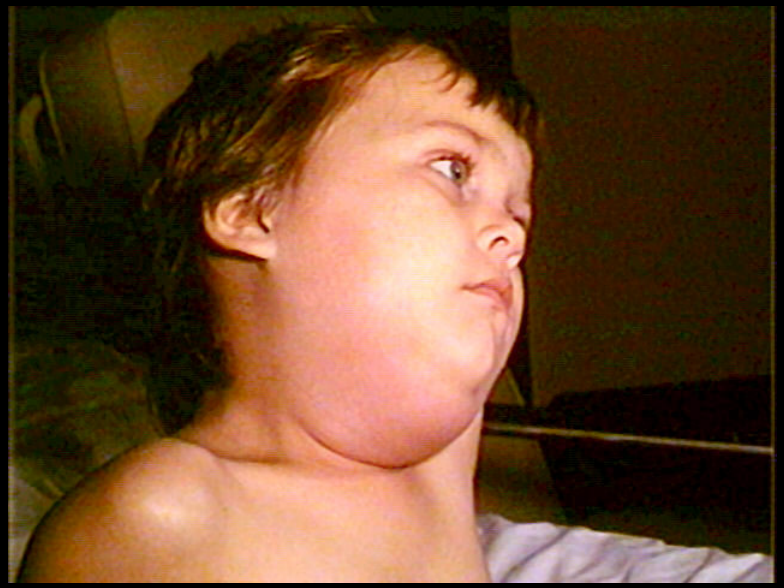
Funding by Neal's Yard Remedies (www.nealsyardremedies.com)

Individual Risk: Fatalities per 1 million people exposed to risk (Log scale)

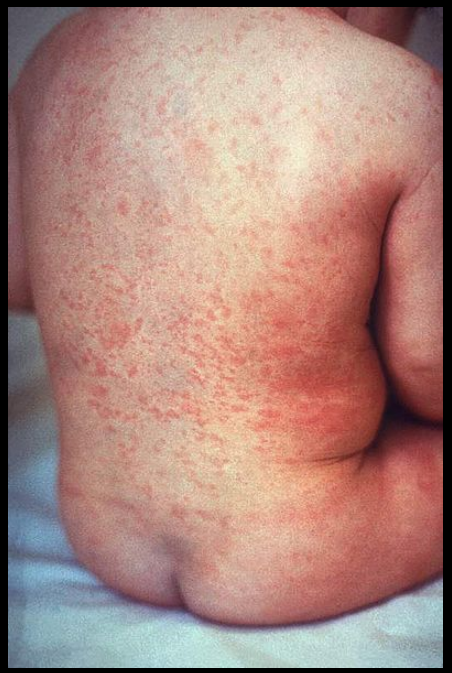
Risk

http://anhinternational.org/

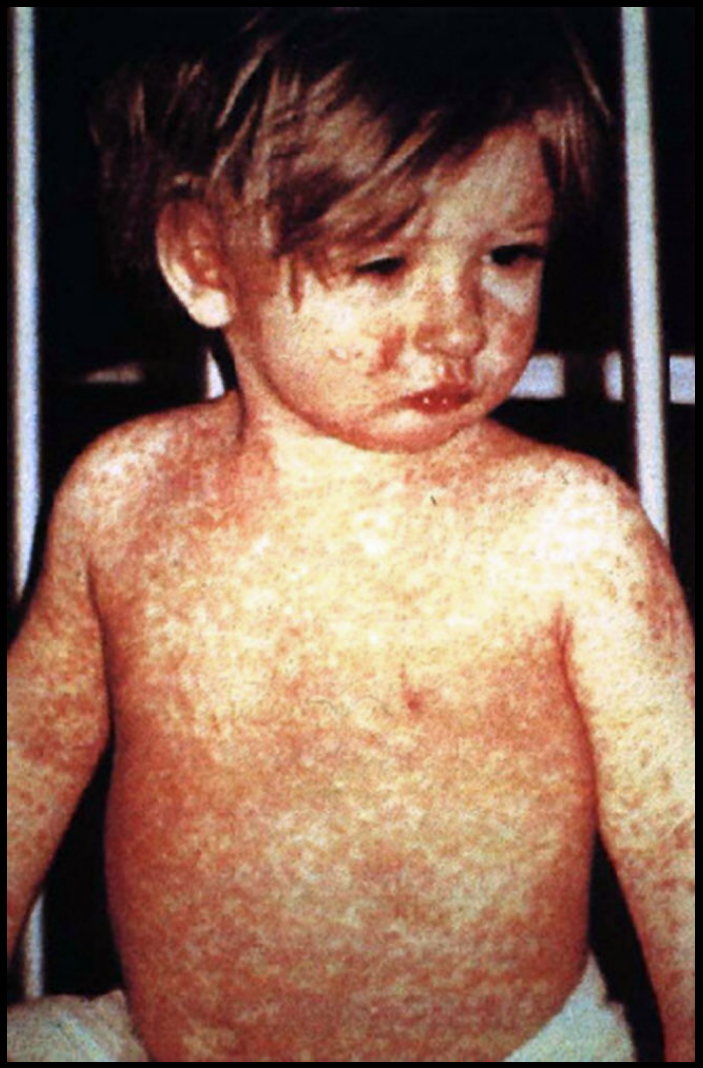
Let’s not forget



Mumps



Rubella / German measles

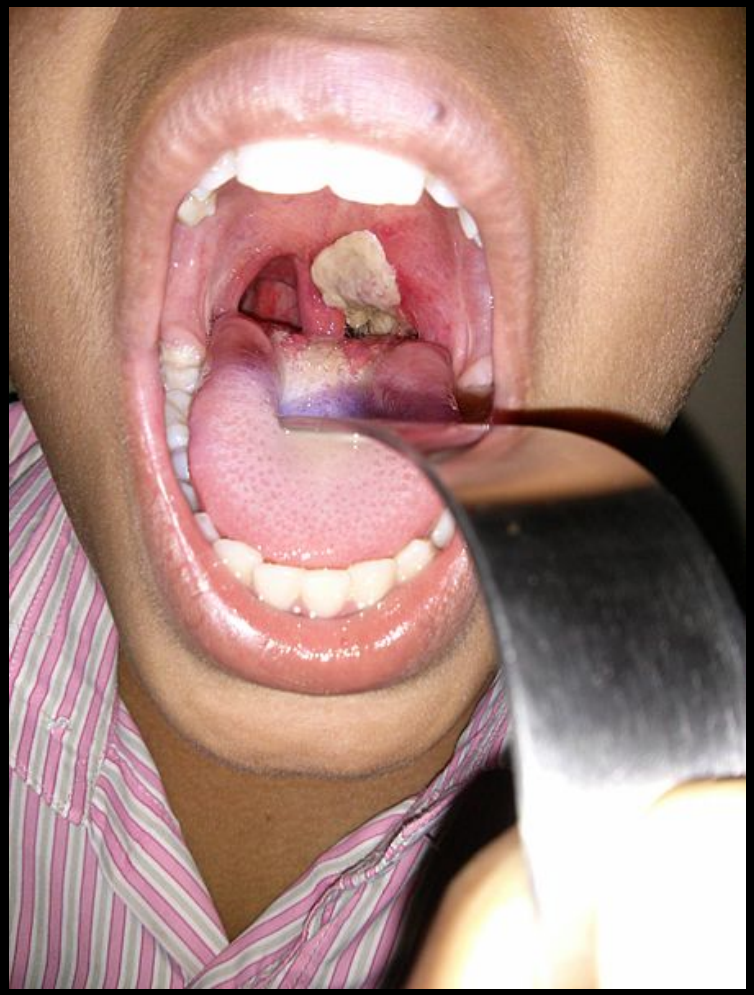


Measles

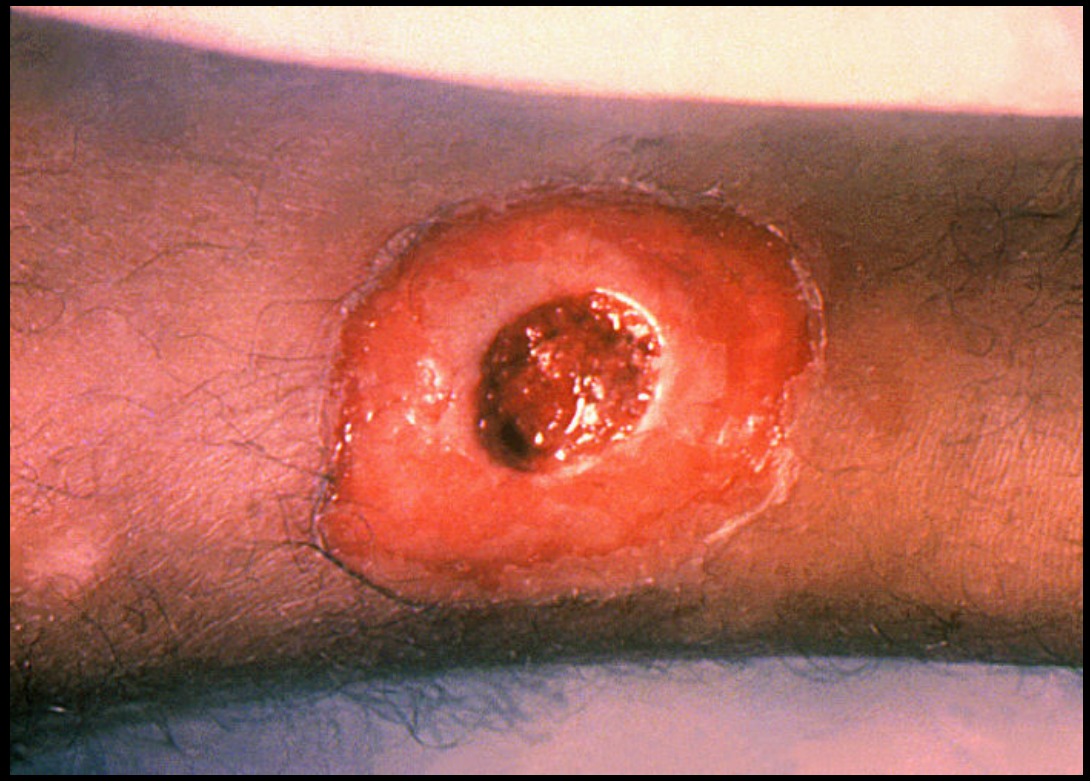
wikipedia.org

Let’s not forget

Diphtheria



Diphtheria



Diphtheria, skin lesion

wikipedia.org

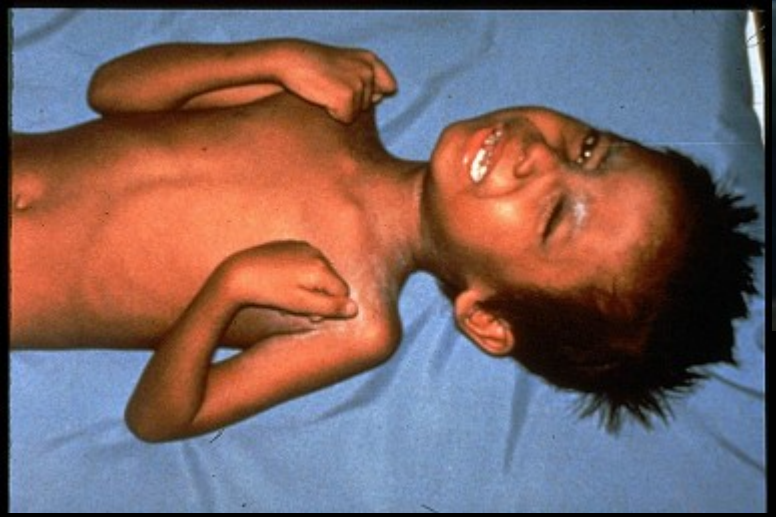
Let’s not forget

Polio

un.org

Let’s not forget

Tetanus



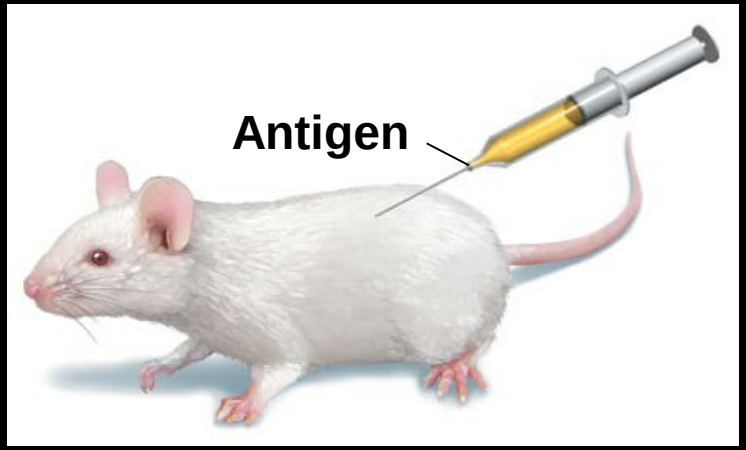
freeinfosociety.com wikipedia.org braindiseases.org

Diagnostic Immunology

Two major problems to solve!

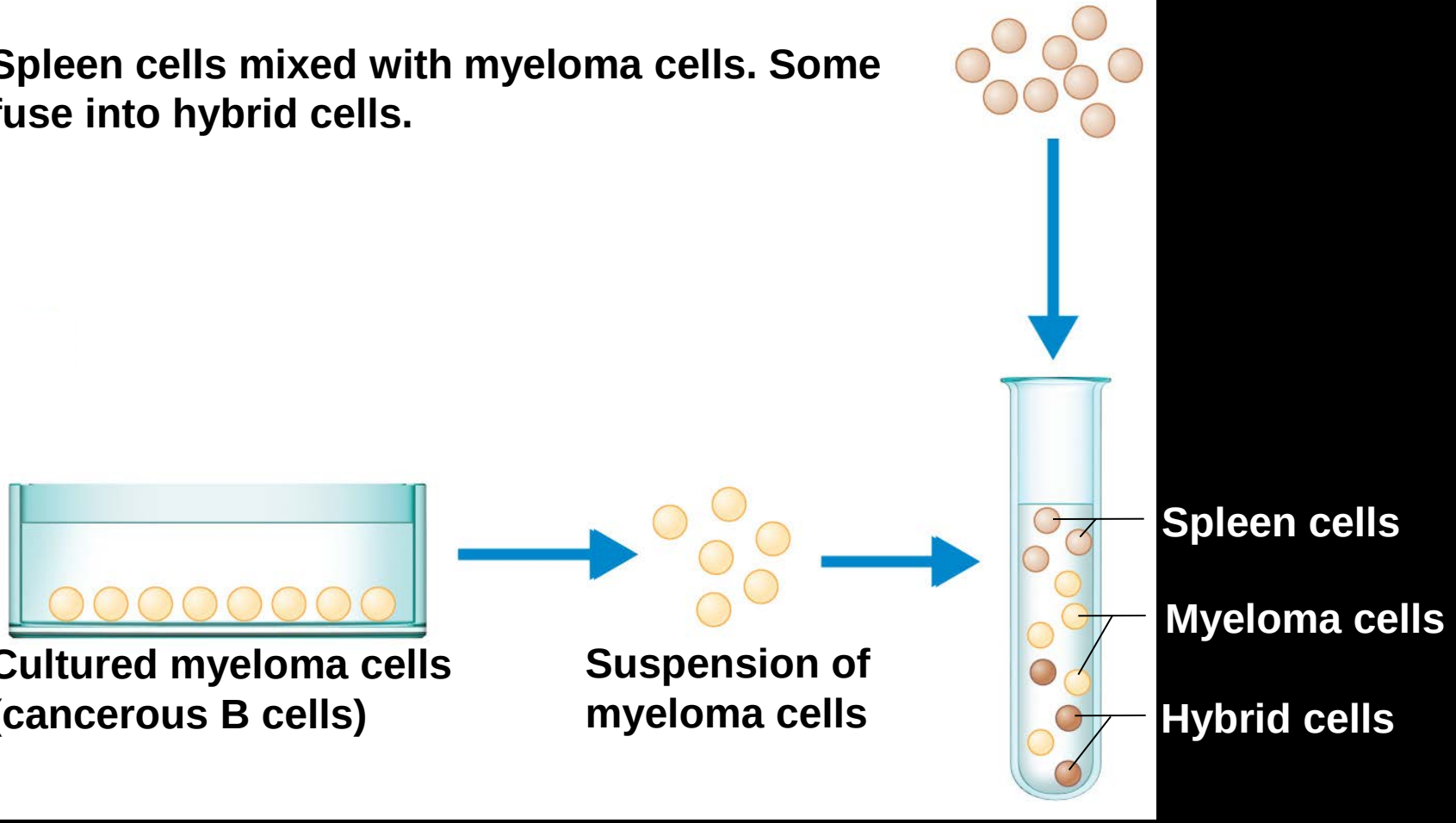
Figure 18.2.1-2 The Production of Monoclonal Antibodies.

1. Mouse injected with antigen. Antibodies produced.



2. Mouse spleen removed. Contains B cells that produce antibodies.

3 Spleen cells mixed with myeloma cells. Some fuse into hybrid cells.



Cultured myeloma cells (cancerous B cells)

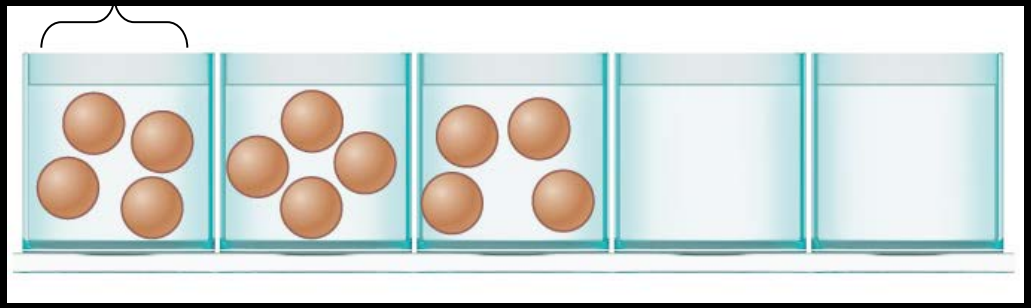
Suspension of myeloma cells

4 Mixture of cells placed in selective medium that allows only hybrid cells to grow.

Figure 18.2.5-6 The Production of Monoclonal Antibodies.

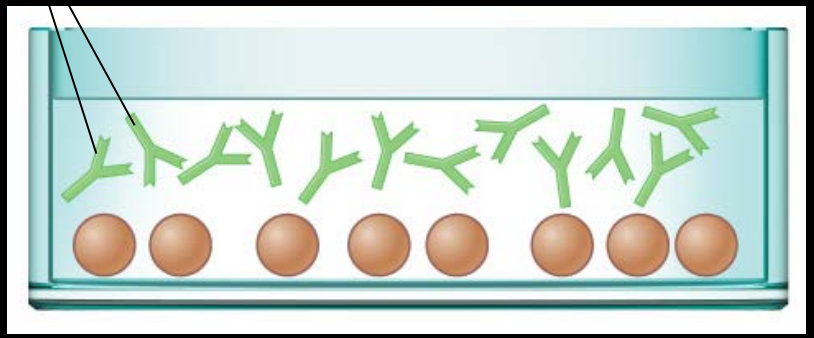
5 Hybrid cells proliferate into clones called hybridomas. The hybridomas are screened for production of the desired antibody.

Hybridomas



Desired monoclonal antibodies

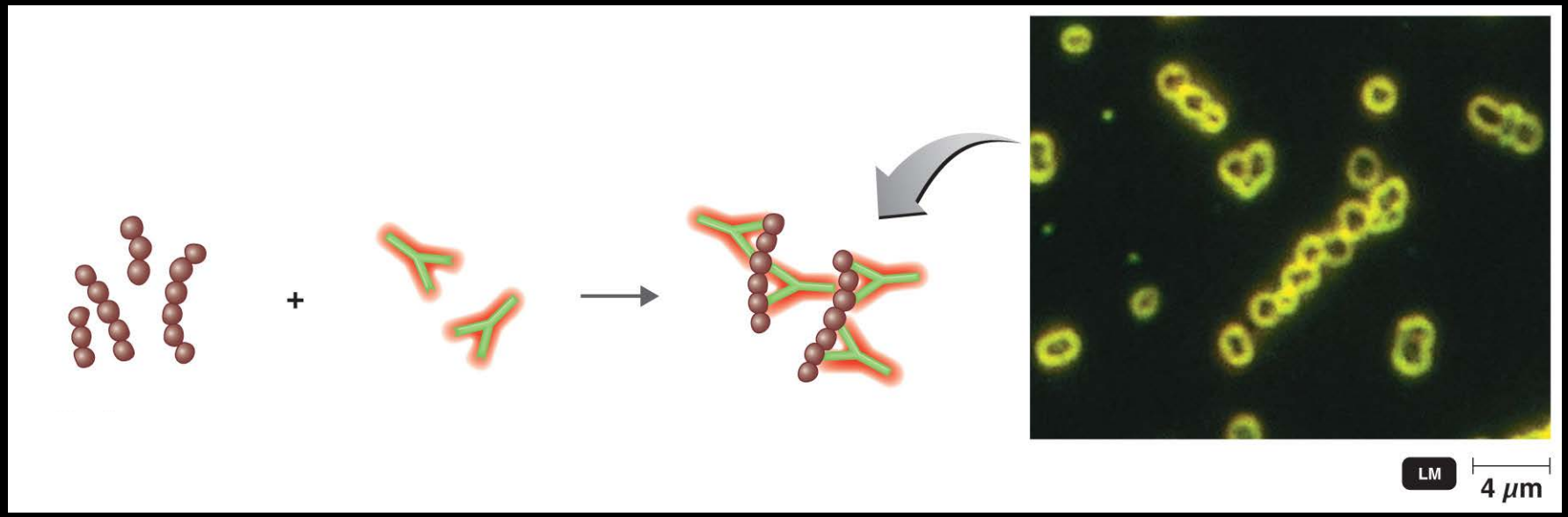
6 The selected hybridomas produce large quantities of monoclonal antibodies, for treating and diagnosing disease.



Naming

Pharmacychoice.com, oncozine.com, novosurge.com, mims.com

Figure 18.11a Fluorescent-antibody (FA) techniques.



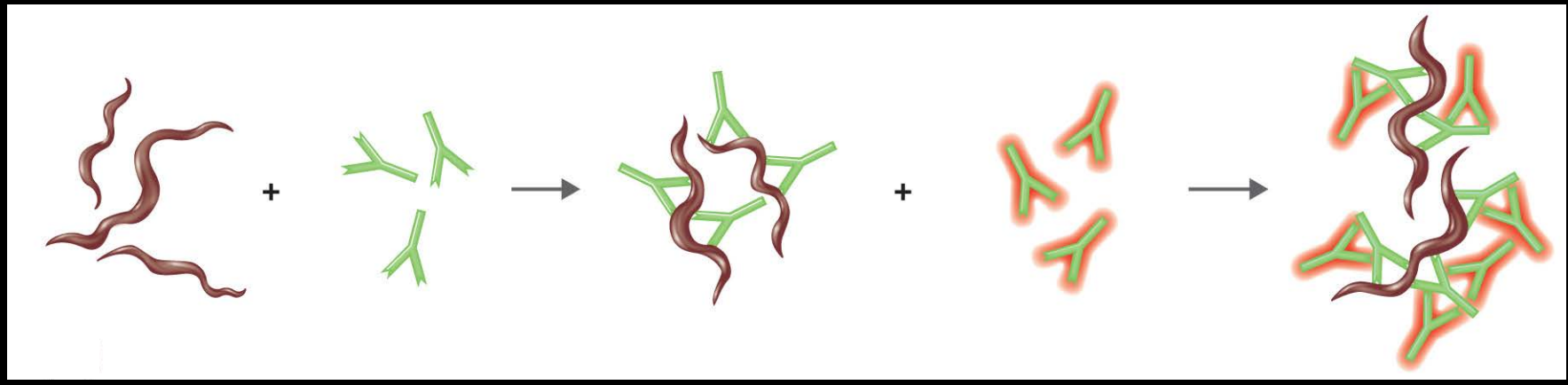
Group A streptococci from patient's throat

Fluorescent dye–labeled antibodies to group A streptococci

Fluorescent streptococci

Figure 18.11b Fluorescent-antibody (FA) techniques.

Reactions in a positive indirect fluorescent-antibody test



T. pallidum from laboratory stock

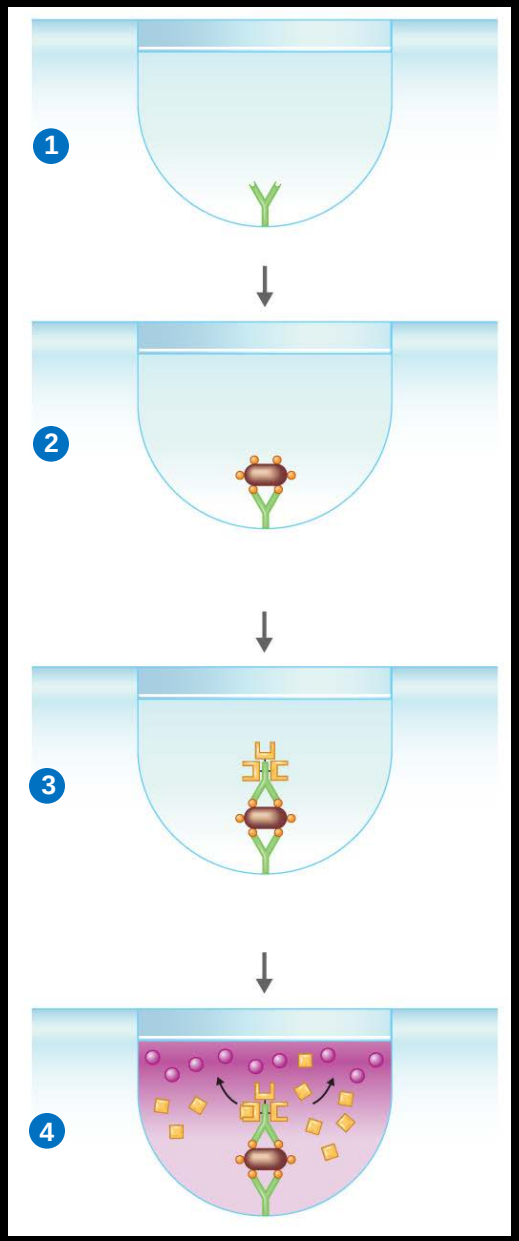
Specific antibodies in serum of patient

Antibodies binding to *T. pallidum*

Fluorescent dye–labeled anti-human immune serum globulin (will react with any immunoglobulin)

Fluorescent spirochetes (see Figure 3.6b)

Figure 18.14: The ELISA method.



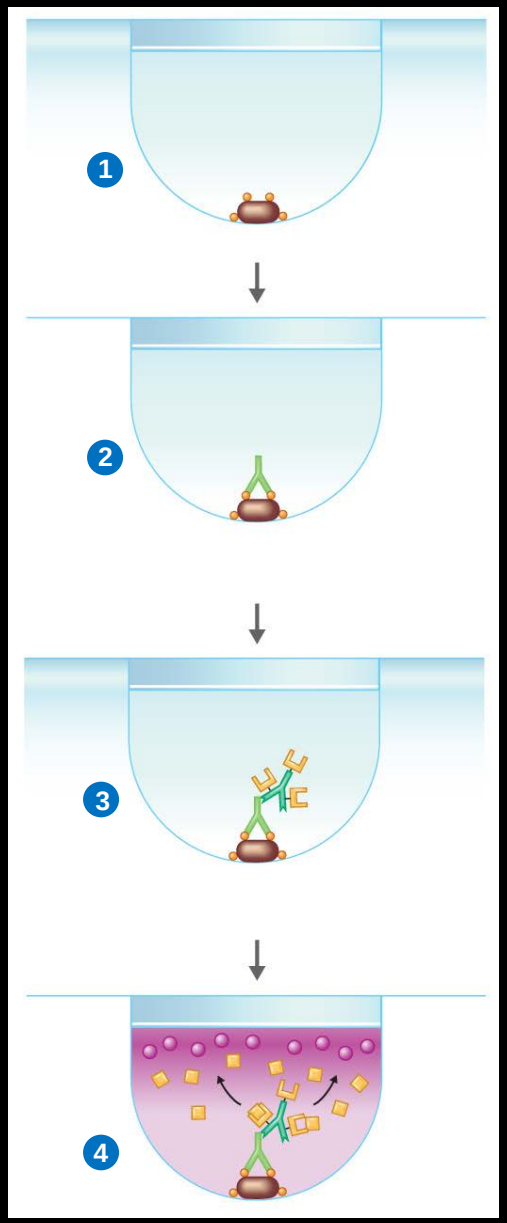
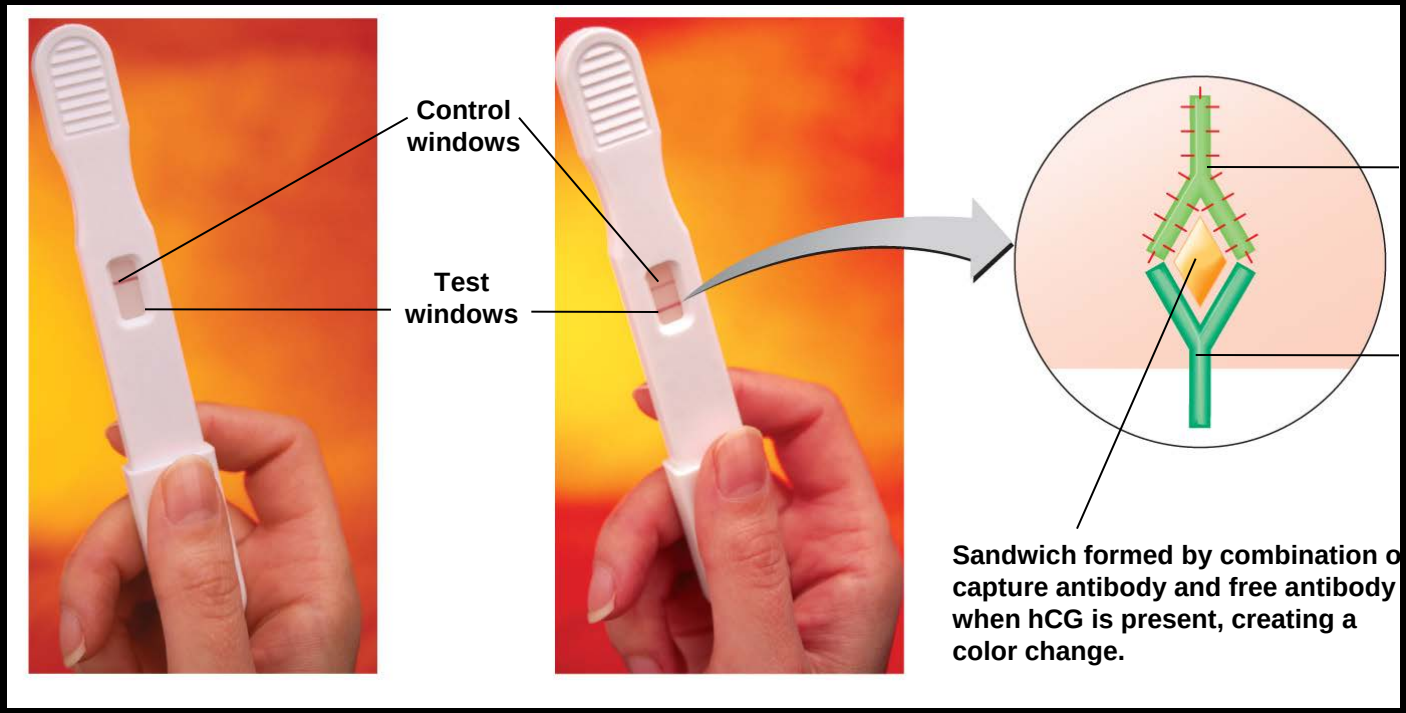


Figure 18.13 The use of monoclonal antibodies in a home pregnancy test.



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