

## 16. Vaccination

### LEARNING OBJECTIVES:

1. Vaccination with anti-Rh protects mothers from immunization with fetal/paternal-derived Rh at birth and prevents hemolytic disease of newborns.
2. Vaccination against infectious disease modifies the course of disease in individuals but does not protect individuals against infection.
3. Vaccination protects populations against infection because it inhibits contagion.
4. Controversies surround vaccination because it is not 100% effective and it carries certain risks to vaccinated individuals. Some vaccines have risks of contagion (vaccinia and oral polio vaccine).
5. Most vaccines work by inducing immune responses that are cross-reactive to the pathogen or its toxin.
6. Developing a novel vaccine requires: (a) isolating pathogen; (b) characterizing disease & pathogenicity; (c) identifying active immunogen; (d) selecting an adjuvant; (e) selecting a schedule of administration and boosting; (f) selecting a preservative. After full formulation is developed, tests must determine whether the vaccine candidate is safe and effective relative to risk of pathogen and natural disease.
7. So far vaccines have only mimicked natural immune responses that were successful in individuals that had successful responses. Novel approaches are probably required for HIV, malaria, TB, etc.
8. To develop the active immunogen, historically passage in different species was used to attenuate virulence. Increasingly, molecular biology is addressing virulence.
9. ISCOMs and naked DNA may be used to load antigenic peptides onto Class I HLA molecules.
10. Traditional adjuvants may be improved with CpG oligos and cytokines like IL-12.
11. Vaccines that improve responses to Hepatitis B and Human Papilloma Virus prevent cancer in part by decreasing chronic inflammation.
12. Vaccines that may protect against cancer might target idiotypes of B cell tumors or exploit immune responses against tumors that are normally controlled by immunity.

### SUMMARY:

1. Vaccination against smallpox is believed to have saved >200 M lives in the 20<sup>th</sup> Century alone. No other contribution of medicine has approached the impact of vaccination.
2. Vaccination remains a challenge for protecting humans from incidental diseases and increasingly for bio-warfare and bio-terror.