

Active and passive immunization

Active and passive arteficial immunisation

	<u>Active immunisation</u>	<u>Passive immunisation</u>
Speed of response	Delayed	Prompt
Length of response	Long-term	Short-term
Clinical use	Long-term prophylaxis	Treatment, short-term prophylaxis

Passive immunization

- Substitution of missing specific antibodies protecting against infectious disease or treating the infectious disease.
- Used mainly in infectious diseases or diseases caused by toxins.
- Prompt but short-term effect.
- No immunological memory is induced.

Antisera used in human medicine

- Against bacterial infections: Tetanus (human), Diphtheria (equine), Botulism (equine)
- Against viral infections: Hepatitis B (human), Rabies (equine), Varicella-zoster (human), CMV (human), tick-born encephalitis (human), hepatitis A, measles and other viral infections (pooled human immunoglobulin)
- Against snake or black widow spider toxins
- Anti Rh

Non-specific immunoglobulin derivatives

- Obtained from donors' plasma by ethanol extraction.
- Contains almost exclusively IgG, other isotypes are present only in traces.
- Currently only derivatives for intravenous or subcutaneous application are used.

Therapeutic use of immunoglobulin derivatives - I

- Replacement treatment in patients with hypogammaglobulinemia .
- It is only IgG substitution, other isotypes are not present.
- In patients with primary hypogammaglobulinemia it is usually a life-long treatment.

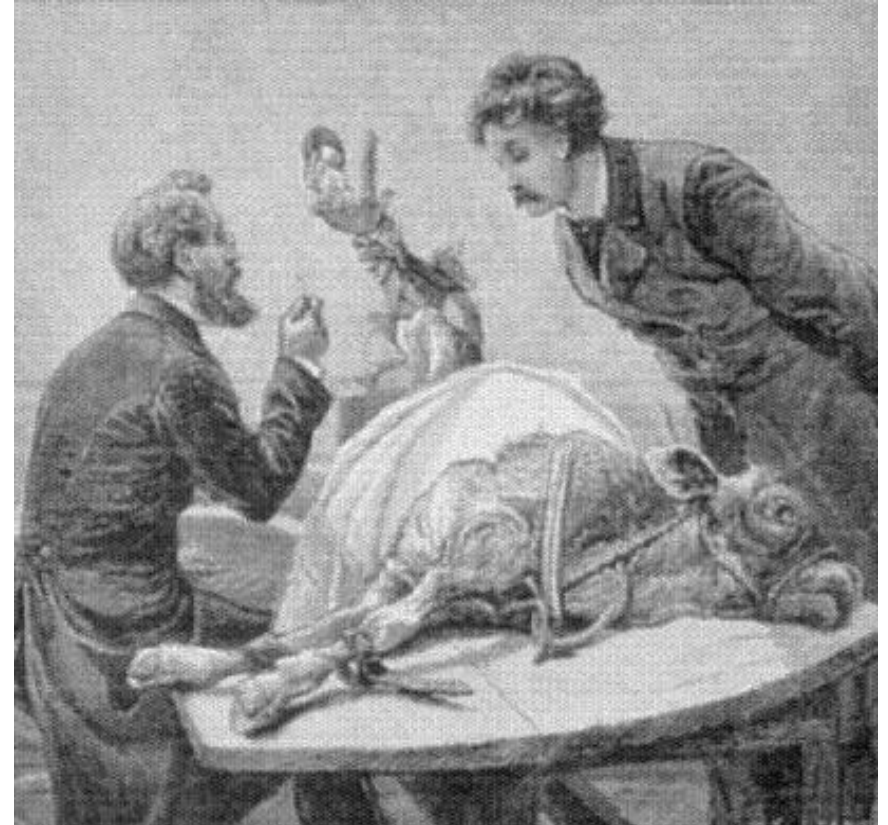
Therapeutic use of immunoglobulin derivatives - II

- High-dose intravenous immunoglobulin treatment can be used in severe inflammatory or autoimmune diseases.
- The mechanism is complex (inhibition of phagocytosis, suppression of B-cells function, effect on T-cell functions) .
- The efficacy is variable and in situation difficult to predict.
- Most effective in Kawasaki disease and immune thrombocytopenic purpura (ITP).

Active immunization (vaccination)

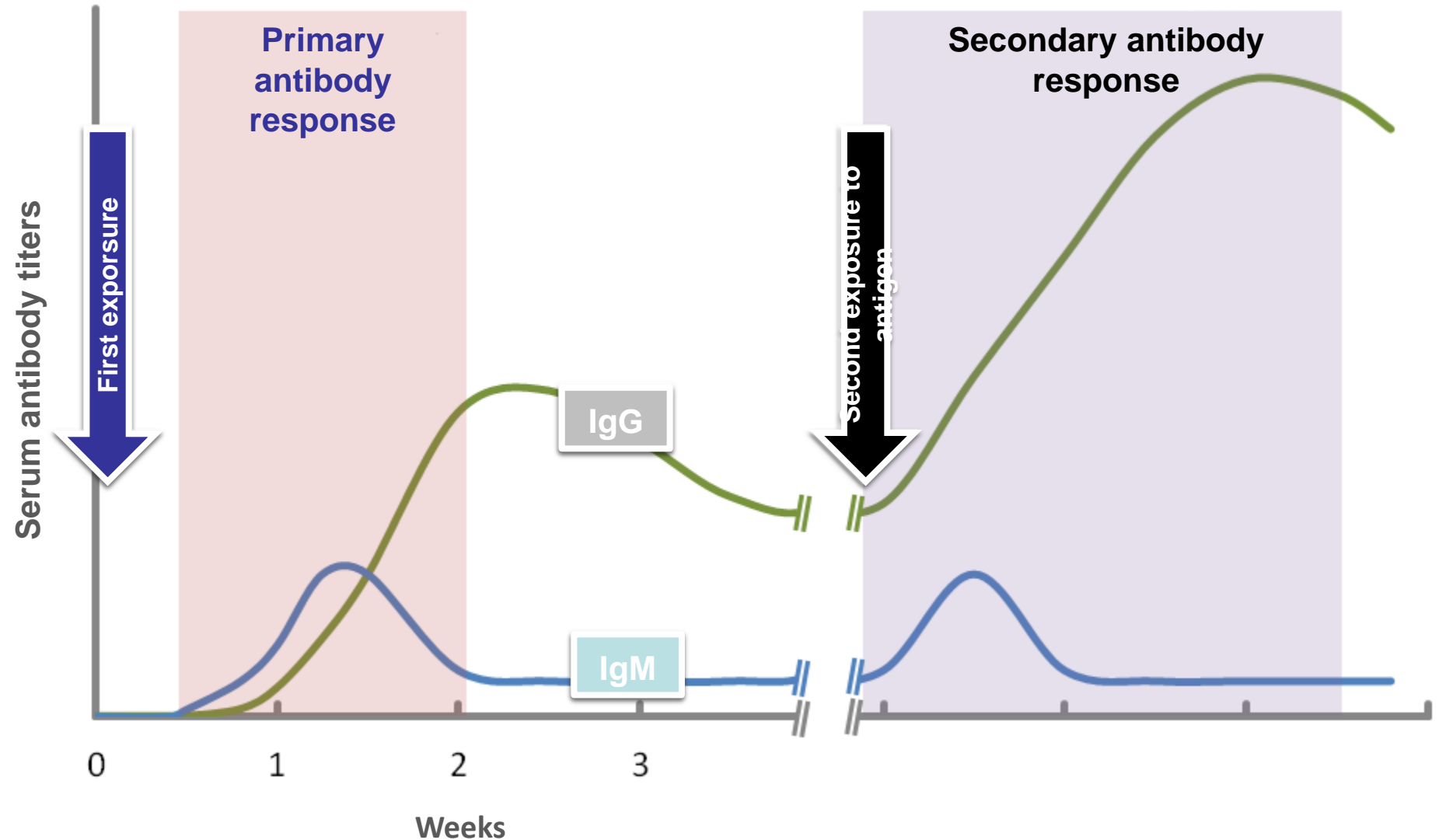
- Induction of immune memory by a harmless antigen.
- In the case of infection by a pathogen prompt secondary immune response protects the immunized person from the disease.
- Has protective, but no therapeutic effect.

Edward Jenner

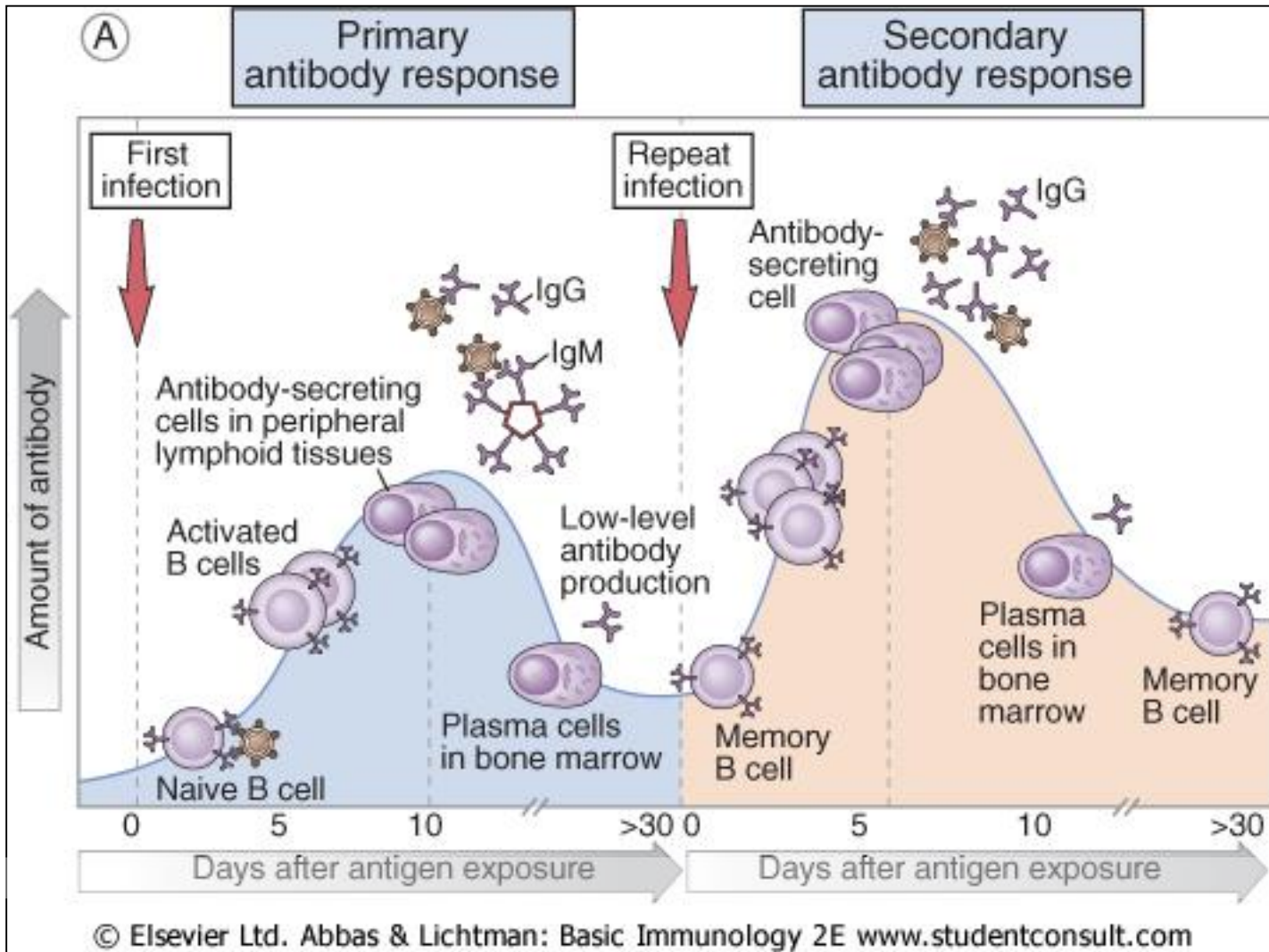


Discovery of small pox vaccine

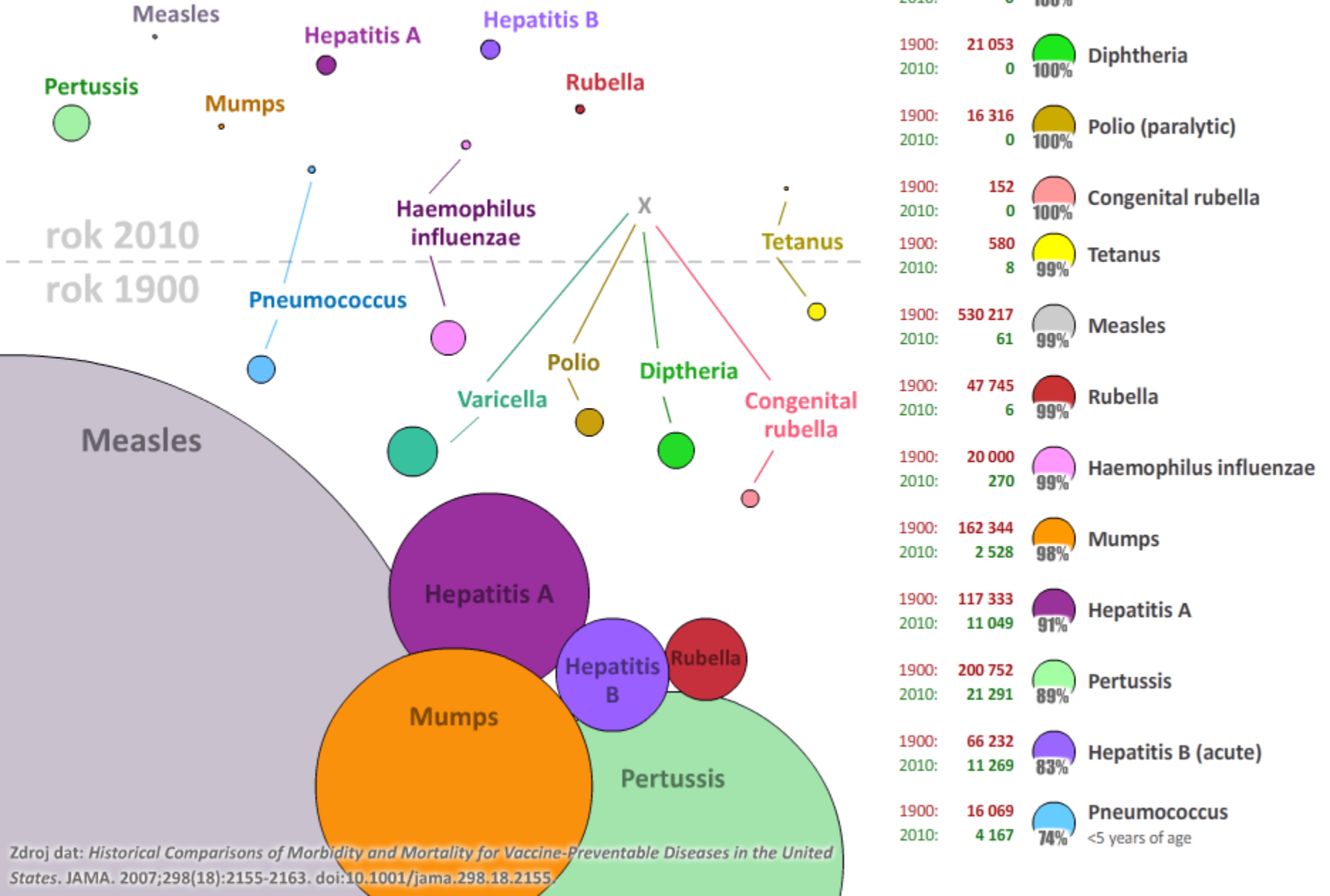
Primary and secondary immune response



Primary and secondary immune response



The effect of vaccination on infectious diseases occurrence in USA



Zdroj dat: *Historical Comparisons of Morbidity and Mortality for Vaccine-Preventable Diseases in the United States*. JAMA. 2007;298(18):2155-2163. doi:10.1001/jama.298.18.2155

„Classical“ vaccines

- **Atenuated microbes:** mumps, measles rubella (MMR vaccine), rotavirus varicella, BCG (against TBC), cholera, yellow fever, poliomyelitis,
- **Inactivated microorganisms:** rabies, hepatitis A, tick-born encephalitis, poliomyelitis, cholera, plague. Formerly pertussis.
- **Toxoids:** tetanus, diphtheria

„Modern“ vaccines

- **Subunit:** influenza, pertussis
- **Polysaccharide:** Haemophilus influenzae B (conjugated), Meningococcus (conjugated group B, nonconjugated the remaining serotypes), Pneumococcus (conjugated)
- **Recombinant:** hepatitis B
- **Virus-like particles** : papillomavirus

„Future (?)“ vaccines

- Synthetic polypeptides
- Antiidiotype antibodies
- DNA vaccines
- RNA vaccines
- Vector vaccines
- Antigens inserted into food (bananas, potatoes)

he DNA segment encoding the respective antigen is inserted with a suitable p

DNA-vaccines

The DNA segment encoding the protective antigen is inserted with a suitable promoter into the bacterial plasmid.

Intramuscular, mucosal applications, intraepidermal - "gene gun,"

The antigen is produced in vivo and induces both an antibody and a cellular immune response.

BCG (Bacille Calmette Guérin) vaccine

- Prepared in 1921 - after 13 years of passage of *Mycobacterium bovis*, on potatoes with glycerin and beef bile.
- It has been and is used in protection against *M. tuberculosis* and partly also other mycobacteria.
- It protects mainly against severe disseminated forms of TB.
- It is a live vaccine that stimulates T-lymphocytes, it was given on the 4th day after birth. However, administration was often accompanied by BCG infection, most often BCG lymphadenitis, so most European countries gradually withdrew from routine administration of BCG vaccine in general population.
- Efforts have been made to use BCG in the treatment of tumors (non-specific immunostimulator); currently, local BCG is a treatment of choice in bladder cancer.
- However, current statistics suggest that people who have been given the BCG vaccine may be more resistant to some infections (including COVID 19) - perhaps by a "trained immunity" mechanism.

Other (possible) uses of vaccination approach

- Anti-tumour vaccination – both preventive to therapeutic approaches are used
- Prevention and treatment of Alzheimer disease – anti β -amyloid or τ -protein
- Contraception – most frequently anti-HCG
- Treatment of high blood pressure – enzymes of angiotensin-
renin-aldosterone system
- Vaccination against autoimmune diseases – e.g. against
autoimmune TCR.
- Vaccination against drugs (cocaine, possibly nicotine)