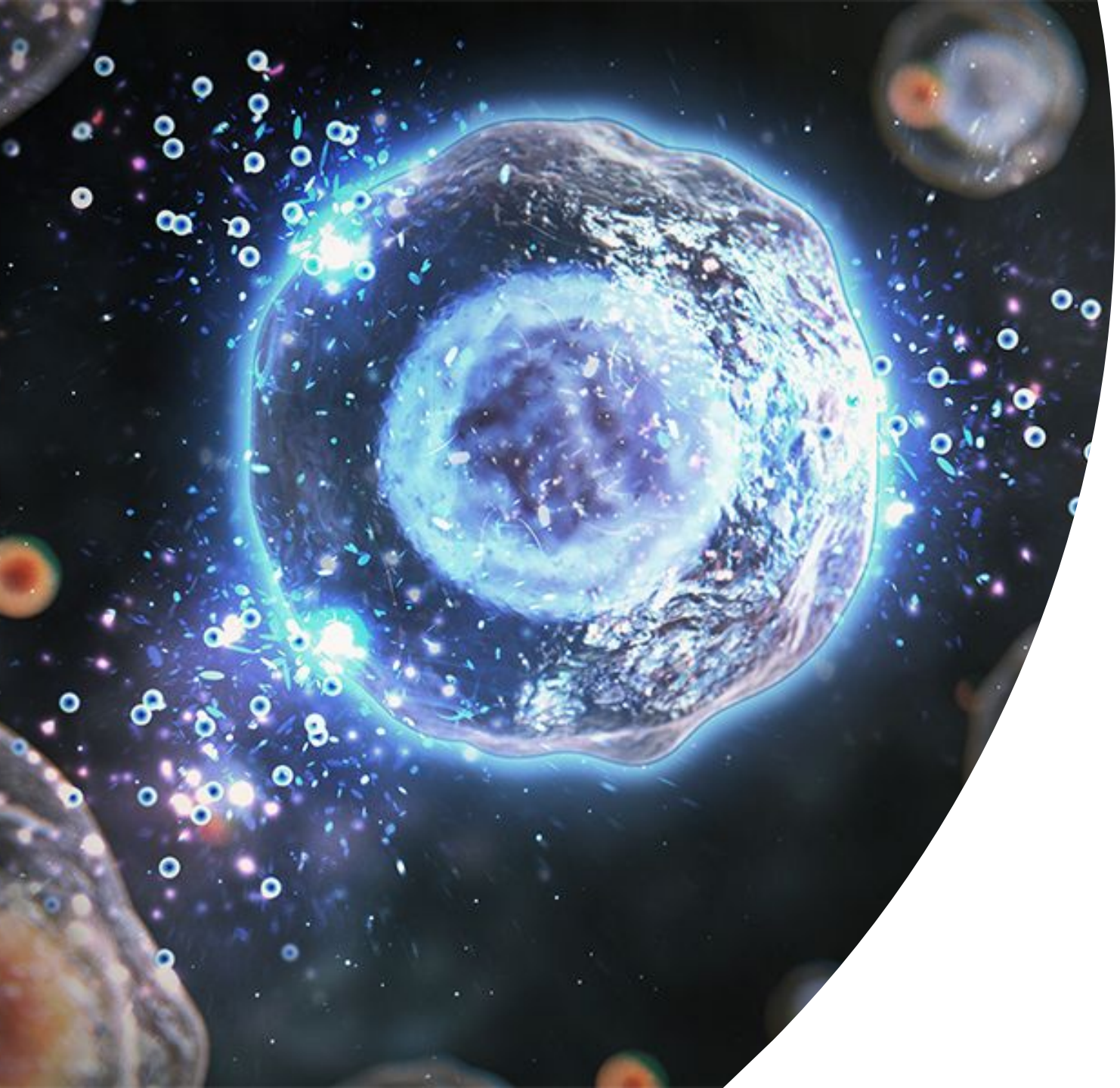
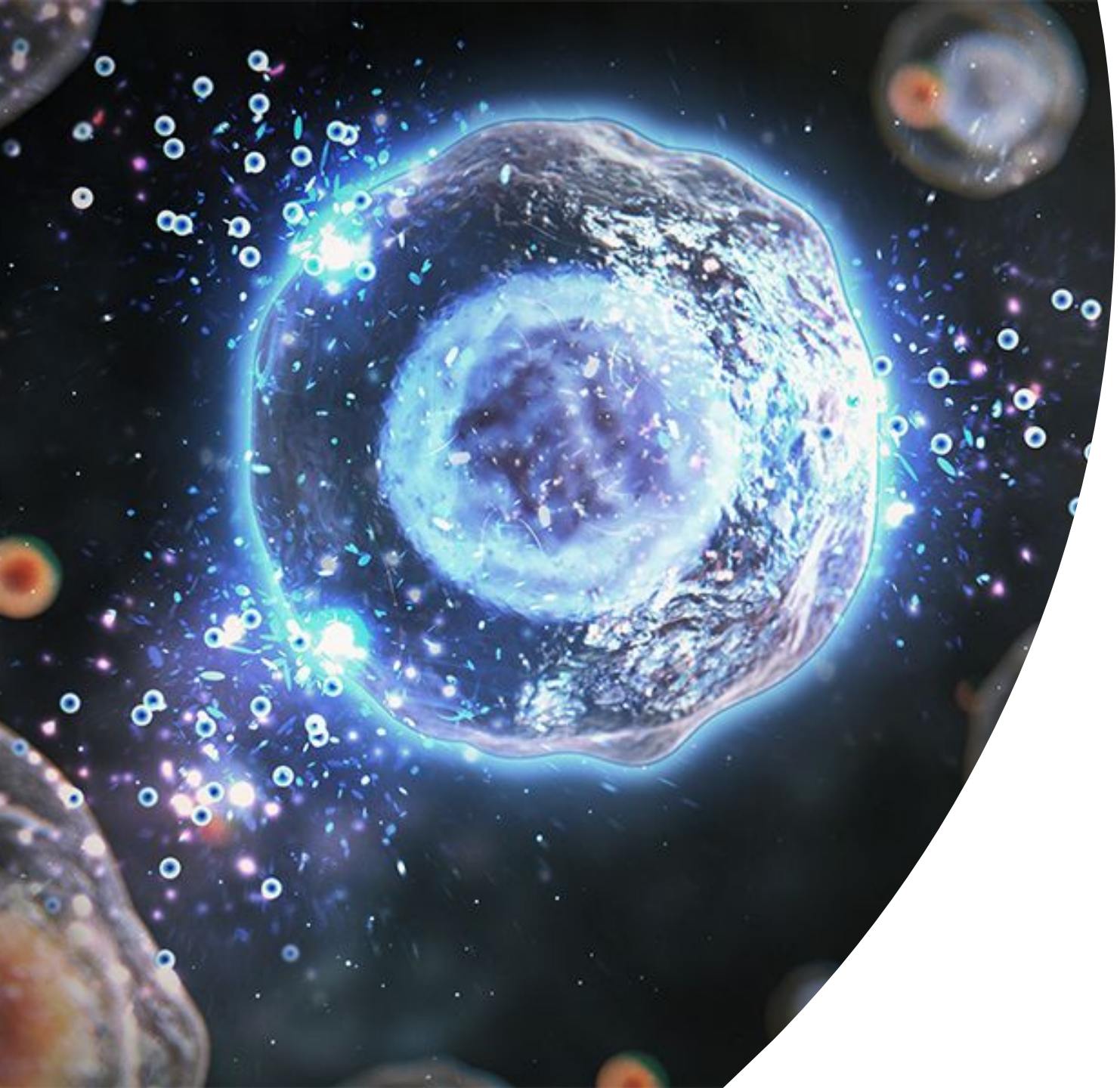


Exercise 10

L9- An overview of vaccines
L10+11-Design and delivery of vaccines

16/04/ 2025

TAs:
Jiayi Tan
(jiayi.tan@epfl.ch)
Arianna Dorschel
(arianna.dorschel@epfl.ch)

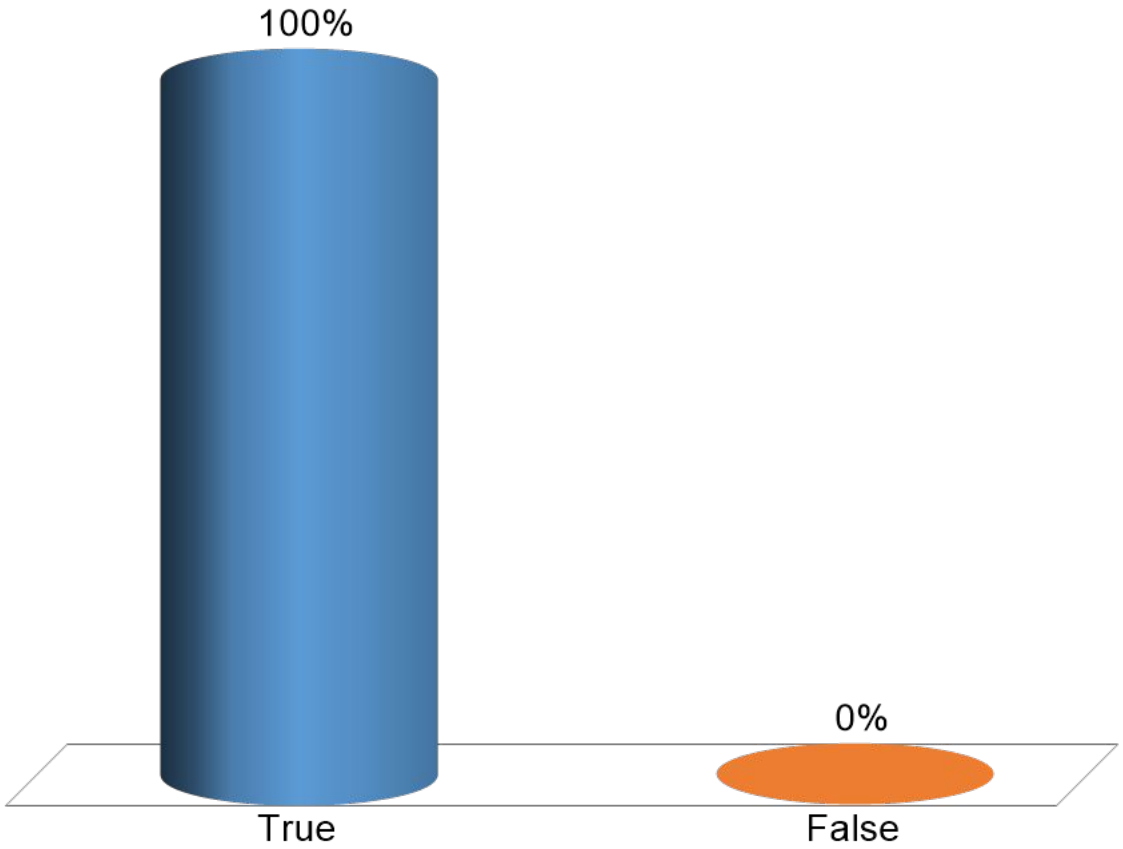


L9- An overview of vaccines

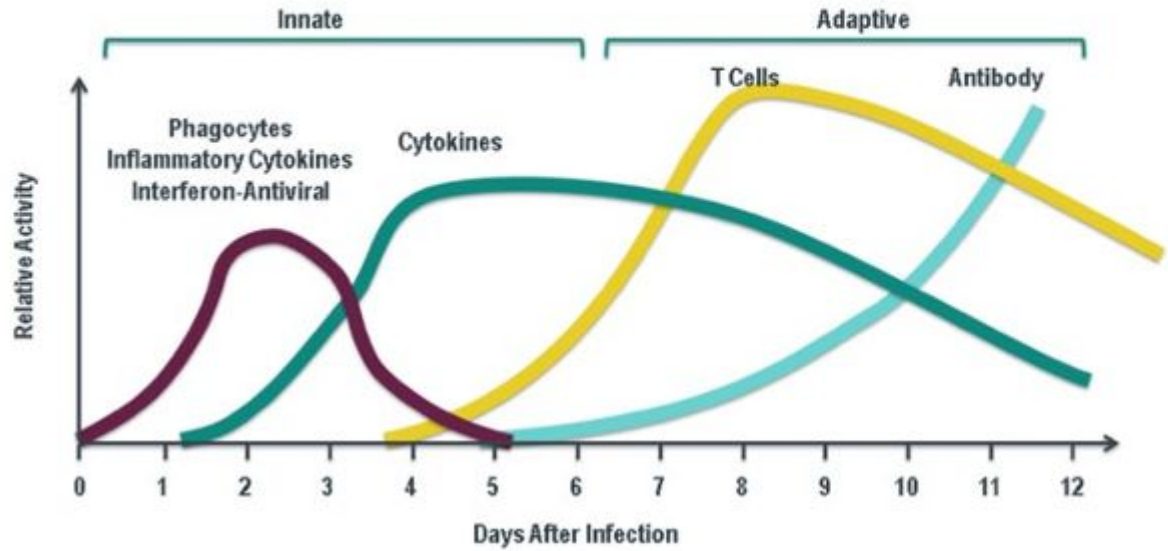
1. An adaptive immune response is generated when naive T cells contact mature, activated antigen-presenting cells in the peripheral lymphoid organs.

A. True

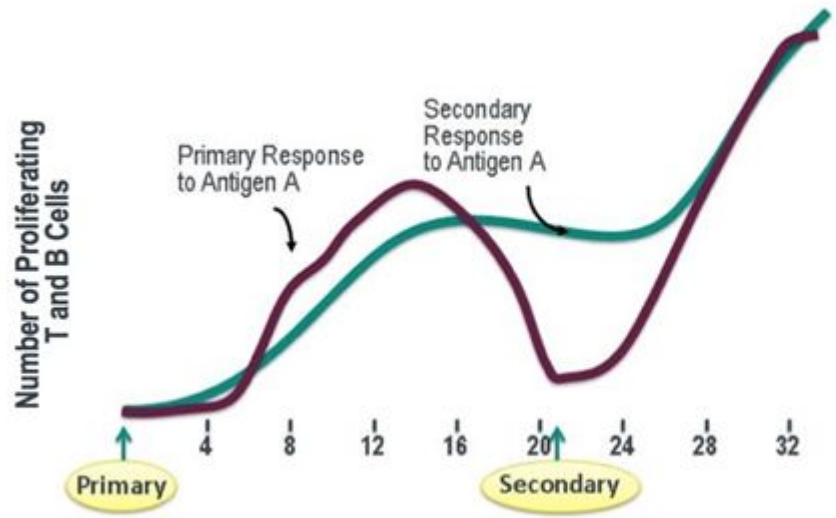
B. False



Adaptive immunity



An **adaptive immune response** is generated when naive T cells contact mature, activated antigen-presenting cells in the peripheral lymphoid organs.



http://www.circumvent-g2.com/immunology.aspx

Infection or vaccination

2. Which one is not correct regarding primary immune response?

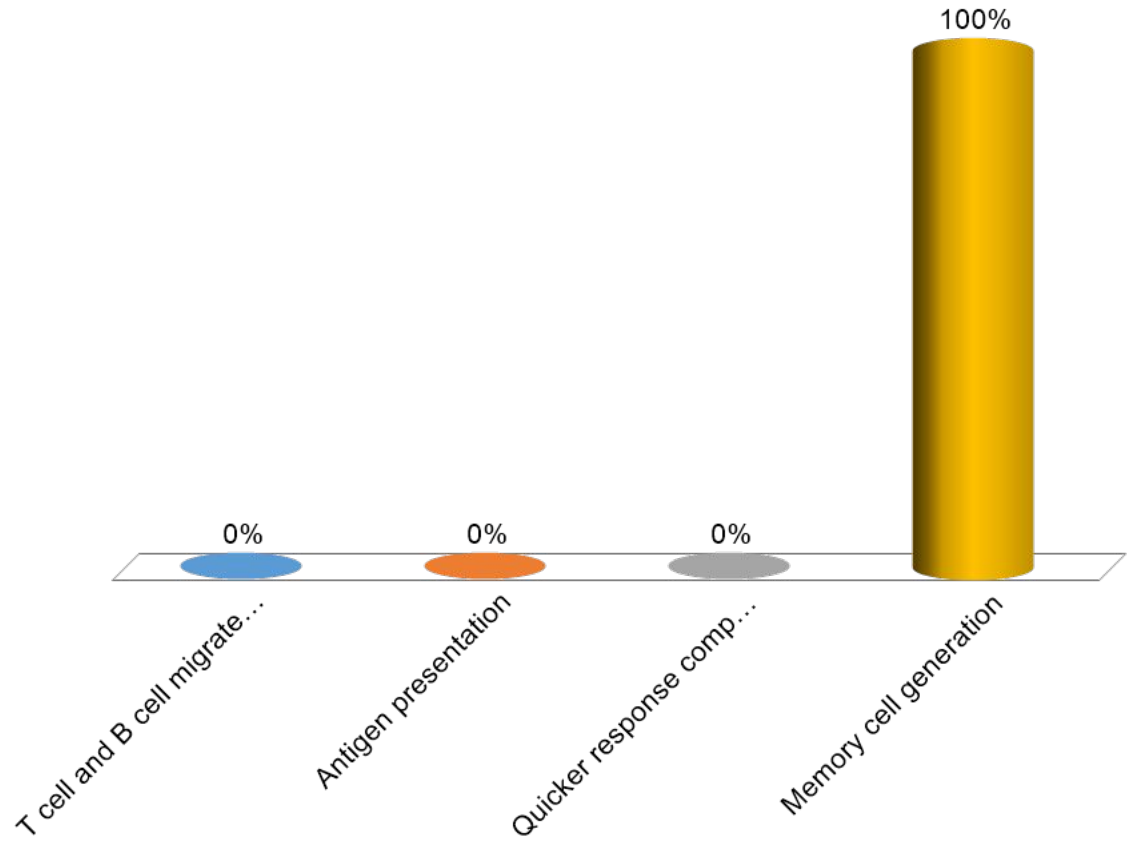
Primary adaptive immune response = first time the adaptive arm (T & B cells) sees that antigen

A. T cell and B cell migrate through chemotaxis

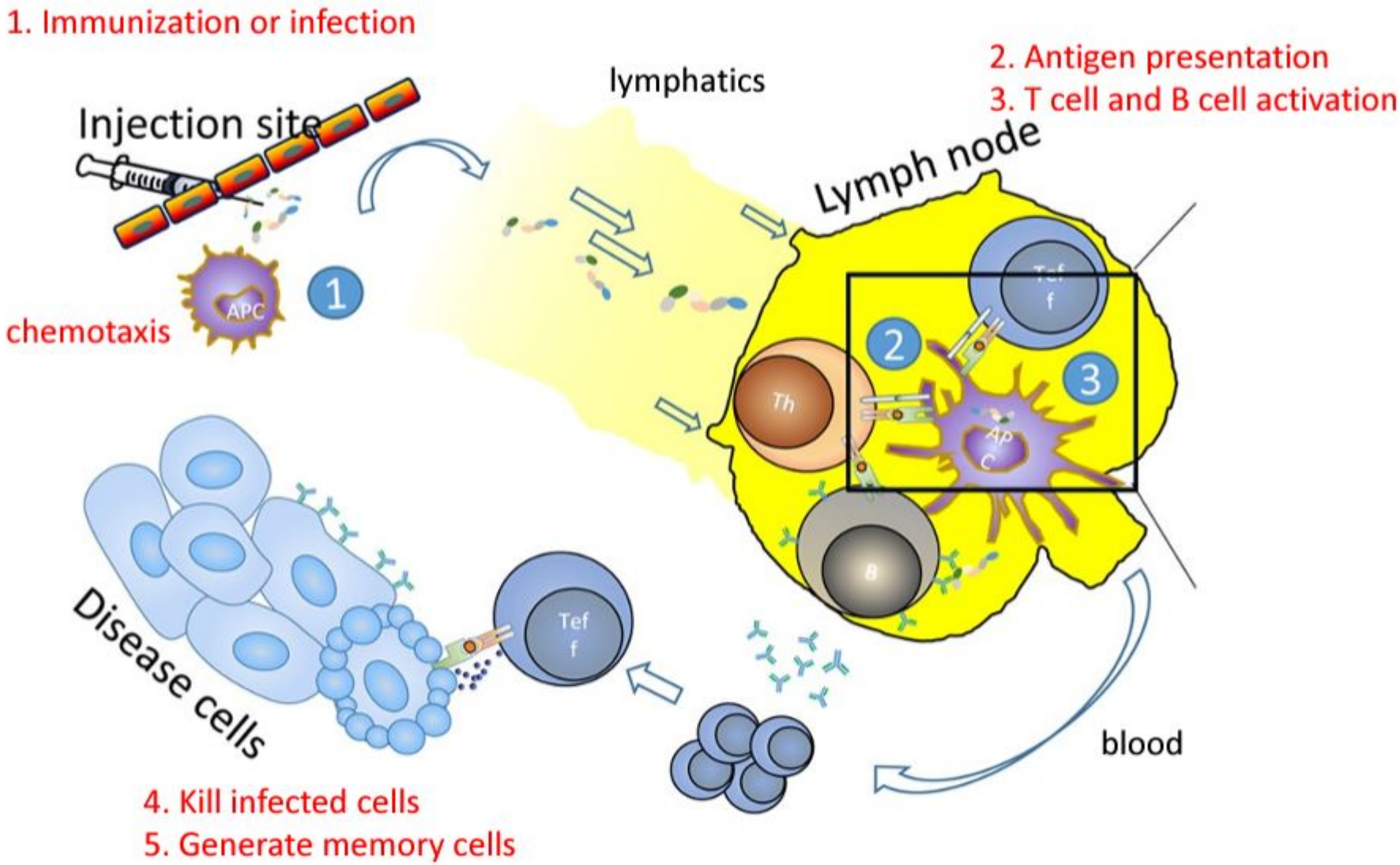
B. Antigen presentation

C. Quicker response compared with secondary response ✓

D. Memory cell generation



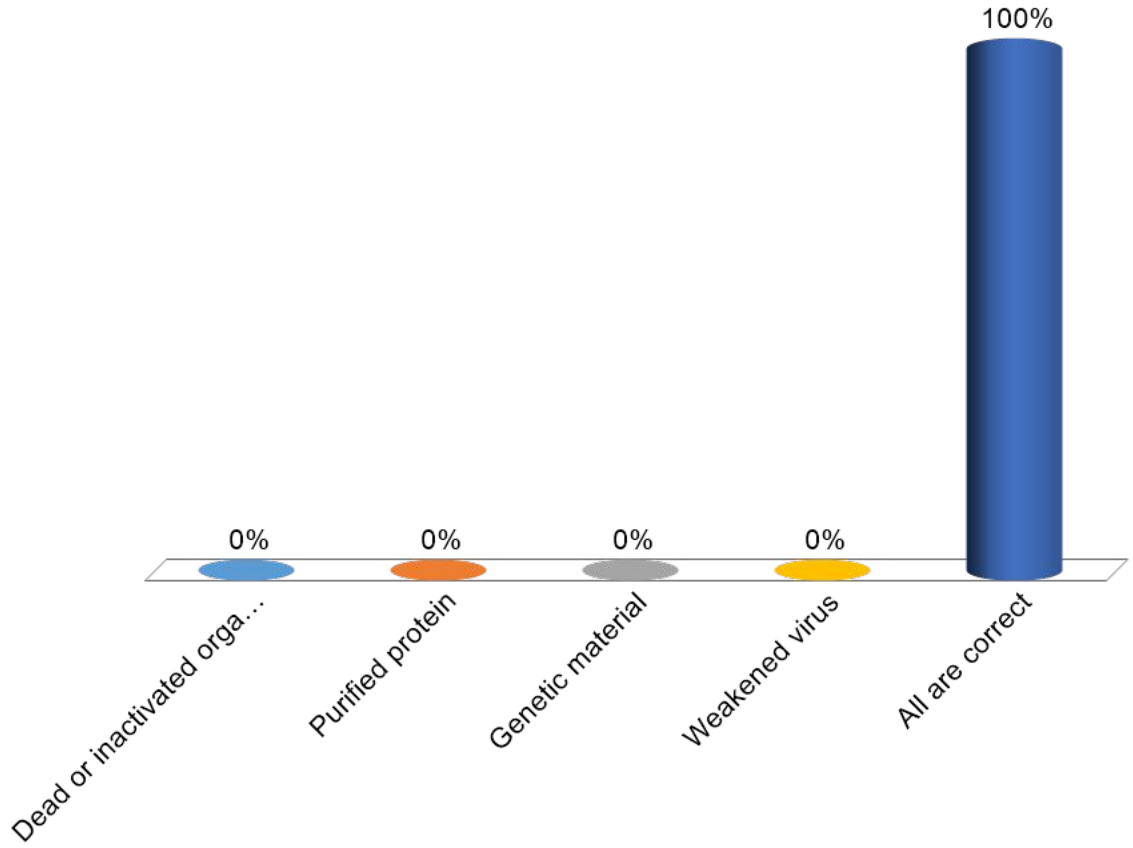
Basic physiology of the primary immune response (i)



Bioconjug. Chem. **26**, 791-801 (2015)

3. Which of these could be designed as vaccines?

A. Dead or inactivated organisms
B. Purified protein
C. Genetic material
D. Weakened virus
E. All are correct ✓



TYPES OF VACCINES

Inactivated

Whole microorganism destroyed by heat, chemicals, radiation or antibiotics.
For influenza, cholera, bubonic plague, polio

Attenuated

Live microorganisms modified to be less deadly or closely-related microorganisms that induce immunity (provoke better immune response but dangerous for immunocompromised individuals)
For yellow fever, measles, rubella, mumps, tuberculosis

Toxoid

Inactivated toxic compounds.
For tetanus, diphteria, snake bites

Subunit

A protein component of the microorganisms e.g. surface proteins or synthetic virus-like particles lacking viral genetic material (unable to replicate)
For hepatitis B, HPV

Conjugate

Polysaccharides on bacterial outer coats that poorly stimulate the immune system (poor immunogen), paired with a protein that is highly immunoogenic (an adjuvant)
For Haemophilus influenzae type

Heterotypic/Jennerian

Pathogens that infect other animals but do not cause disease or cause mild disease in human like cowpox
For tuberculosis (Mycobacterium bovis (BCG))

Monovalent vaccine

Immunise against a single strain of microorganism

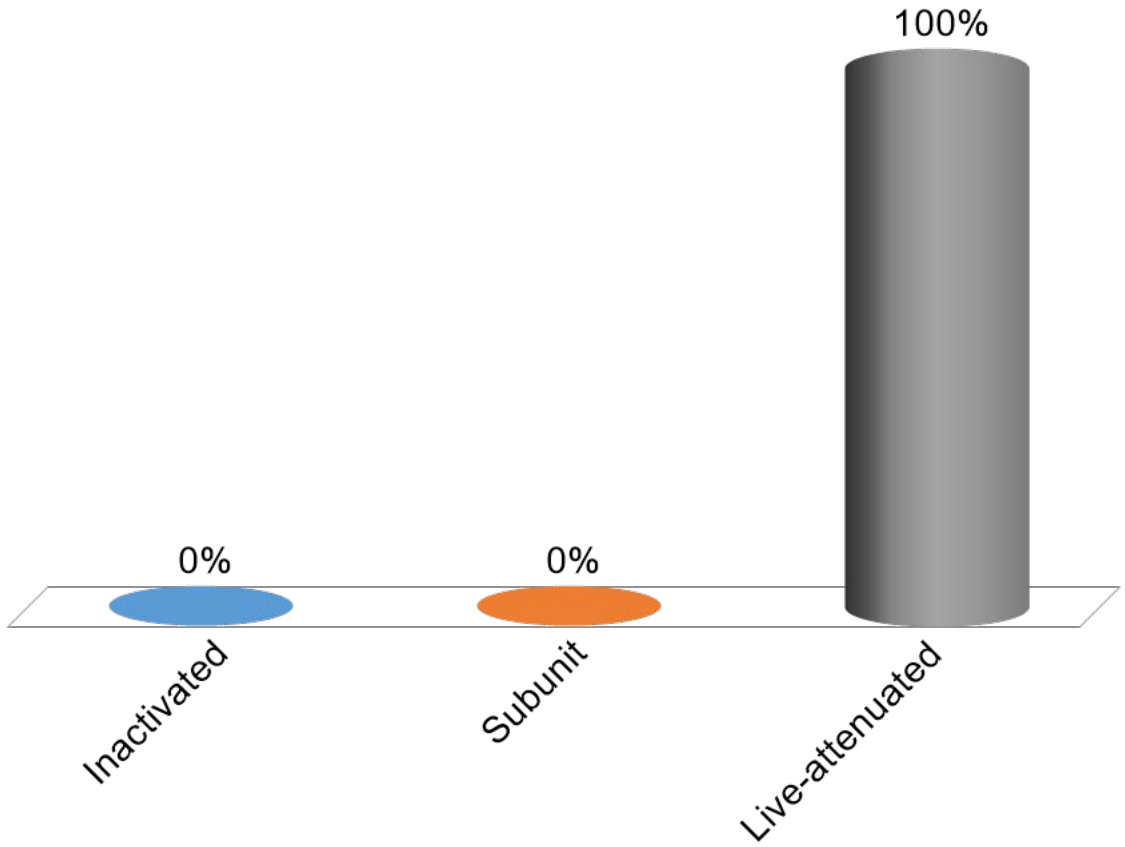
Multivalent vaccine

Immunise against multiple antigens, strains or microorganisms

Infographic by Kong Yink Heay

4. Which vaccine type provides the strongest immune response?

A. Inactivated
B. Subunit
✓ C. Live-attenuated



Two classes of successful, licensed vaccines:

increasing immunogenicity (strength/durability of immune response)

increasing safety

whole microbe

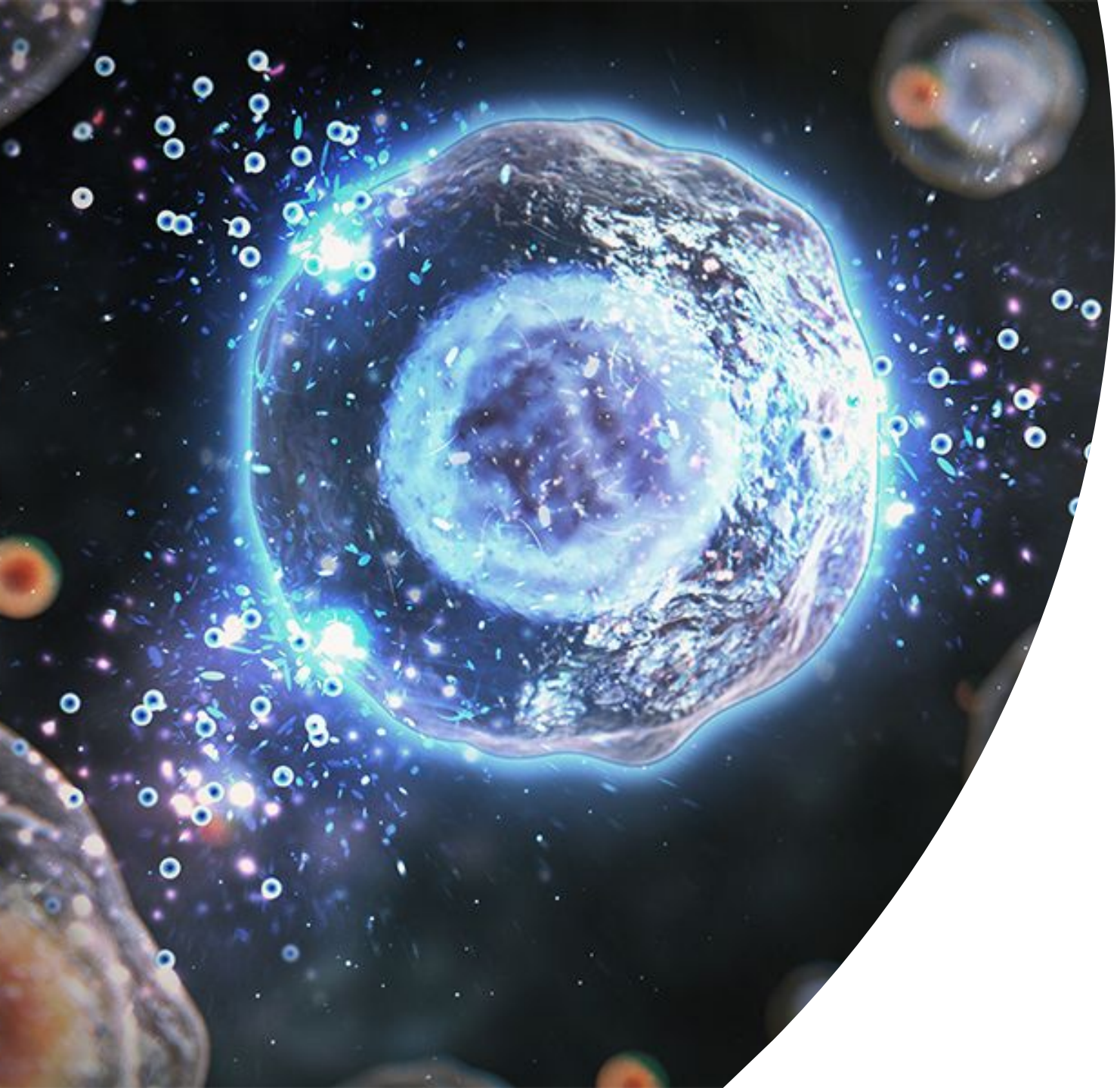
subunit

Type of vaccine:	Live-attenuated	inactivated	subunit
Examples:	Oral Polio, yellow fever, smallpox	Influenza, polio, typhoid	Pneumoccocal, hepatitis B, HPV

live-attenuated unsafe for highly mutable pathogens, inactivated approach is ineffective for many microbes

Issues of potency, durability of response, no CD8 T-cell responses

images: www.ifpma.org



L10+11-Design and delivery of vaccines

1. Which of the following antigen types do NOT exhibit strong tumoral specificity?

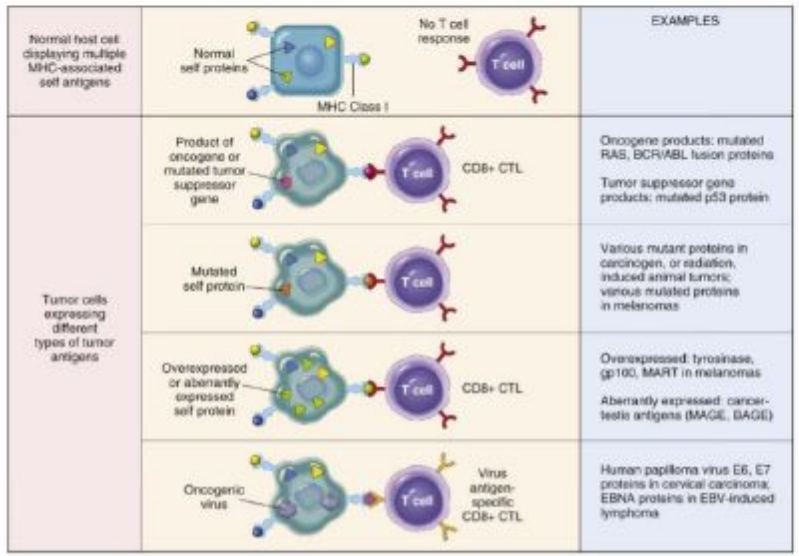
A. Mutation of surface marker

✓ B. Overexpression of a gene

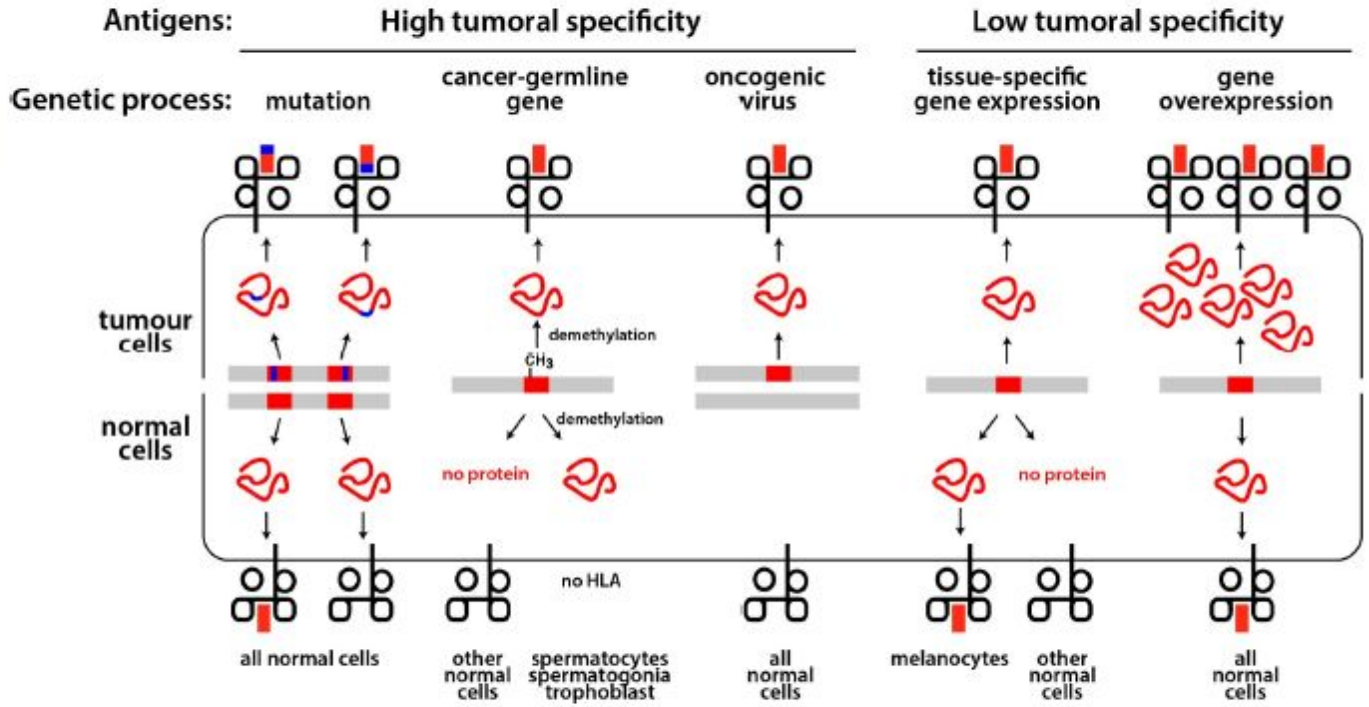
C. Oncogenic viral protein expression

D. Posttranslational modifications of proteins due to a mutation

What antigens are T-cells responding to?



Tumor antigens recognized by CD8+ T cells.



- Neo-antigens
- Cancer-testis antigens (CT Ags, or oncofetal Ags, such as MAGE, NY-ESO-1; expressed only in germ cells but not somatic (tissue) cells
- Viral antigens

http://slideplayer.com/slide/11983008/ https://www.slideshare.net/csbrprasad/neoplasia-robbins-path-13540987

2. What are the rudimentary components of vaccines?

- ✔ A. Antigen
- ✔ B. Adjuvant

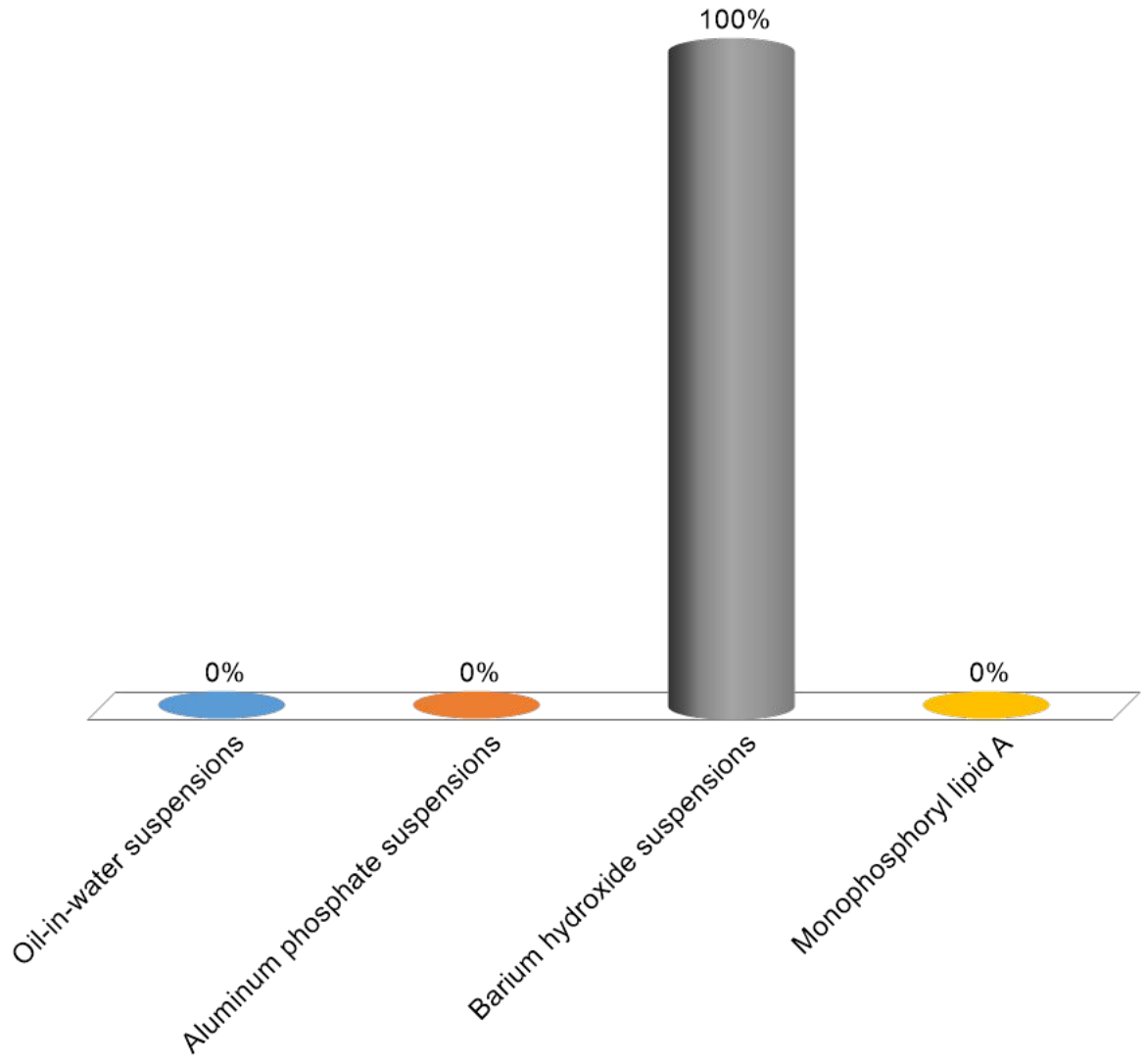
3. Which is NOT a licensed adjuvant?

A. Oil-in-water suspensions

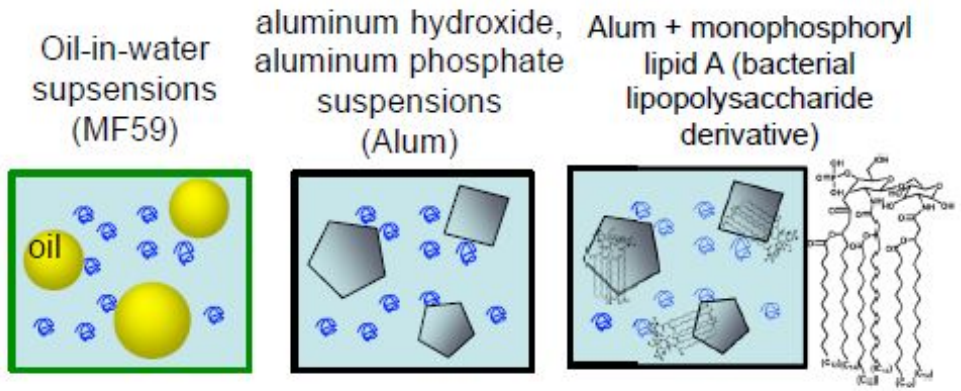
B. Aluminum phosphate suspensions

✓ C. Barium hydroxide suspensions

D. Monophosphoryl lipid A



Only 3 main adjuvants have been licensed for human use so far:



- **Poorly immunogenic on their own**
- **very safe**
- **readily manufactured**

Existing adjuvants:

- increase humoral response, but weak cellular responses and little or no CD8+ T-cell response
- Th2 bias to immune response - not the most effective for intracellular pathogens or cancer
- poor durability of immune response

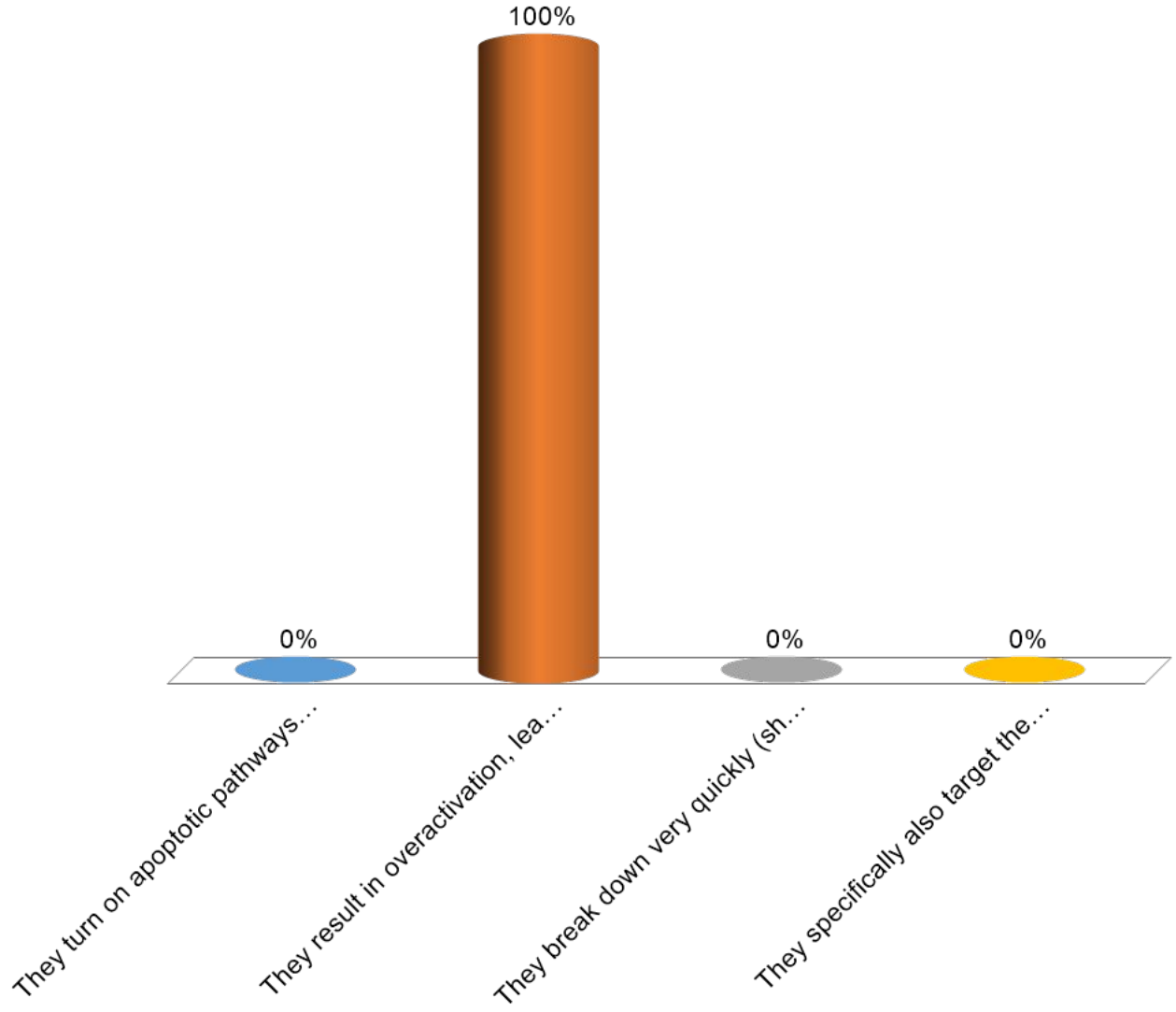
4. If adjuvants can activate the DCs further, what is the problem with using them?

A. They turn on apoptotic pathways in T cells

B. They result in overactivation, leading to severe inflammatory toxicity ✓

C. They break down very quickly (short half-life)

D. They specifically also target the myelin sheath on neuronal axons

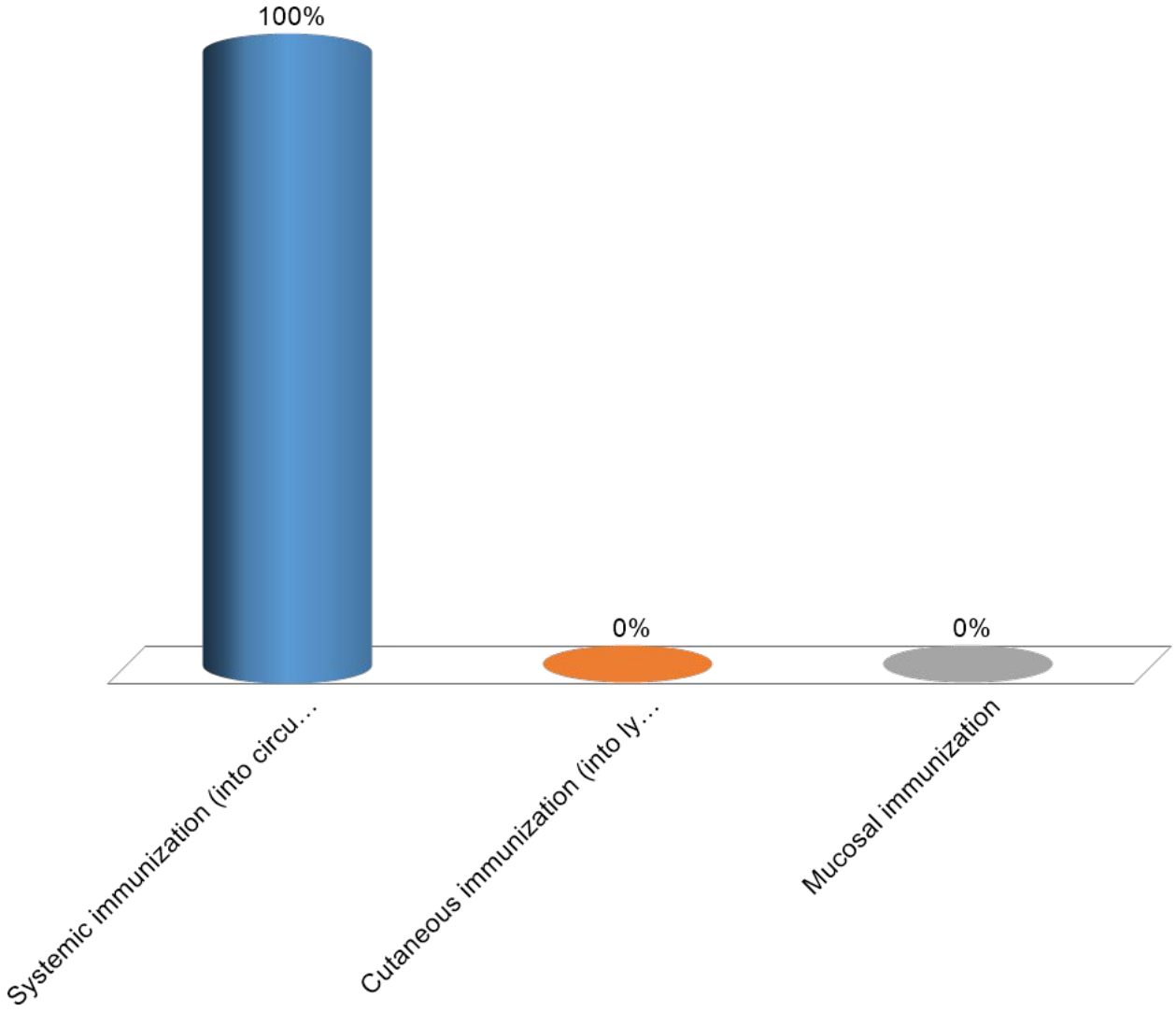


5. What is not an area to target to overcome tissue barriers of vaccines?

A. Systemic immunization (into circulatory system)

B. Cutaneous immunization (into lymph nodes)

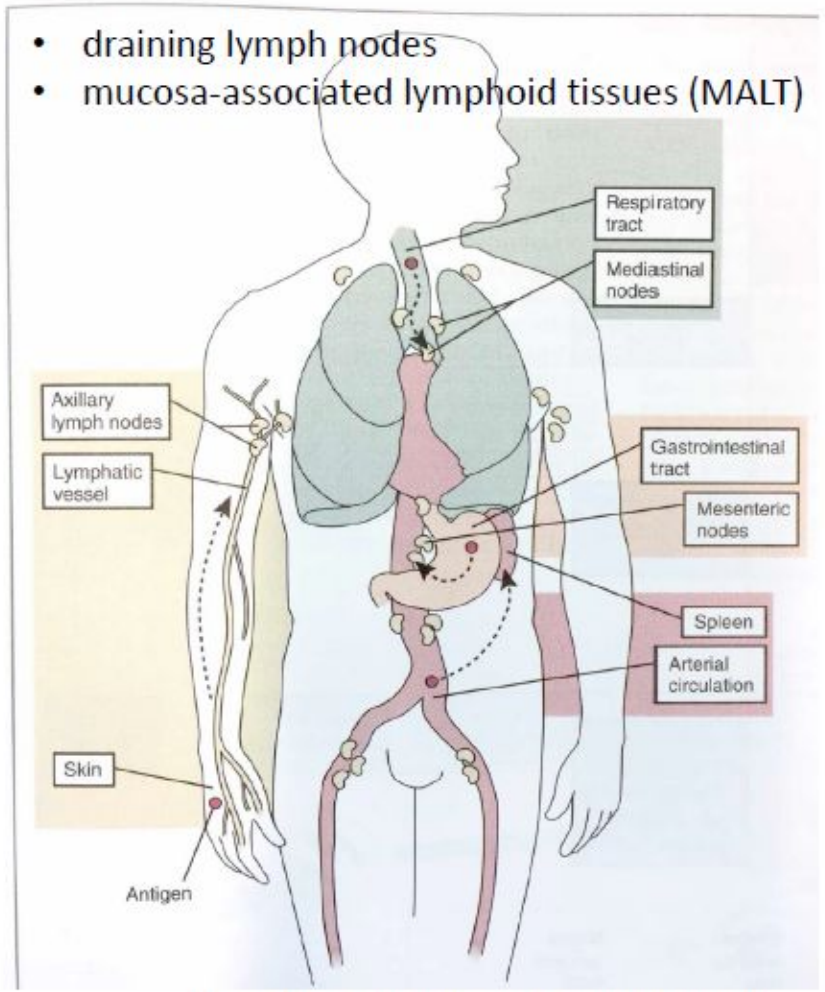
C. Mucosal immunization



Overcoming tissue barriers for vaccines with biomaterial engineering

1. Cutaneous immunization: Target Vaccines to Lymph Nodes

2. Mucosal immunization

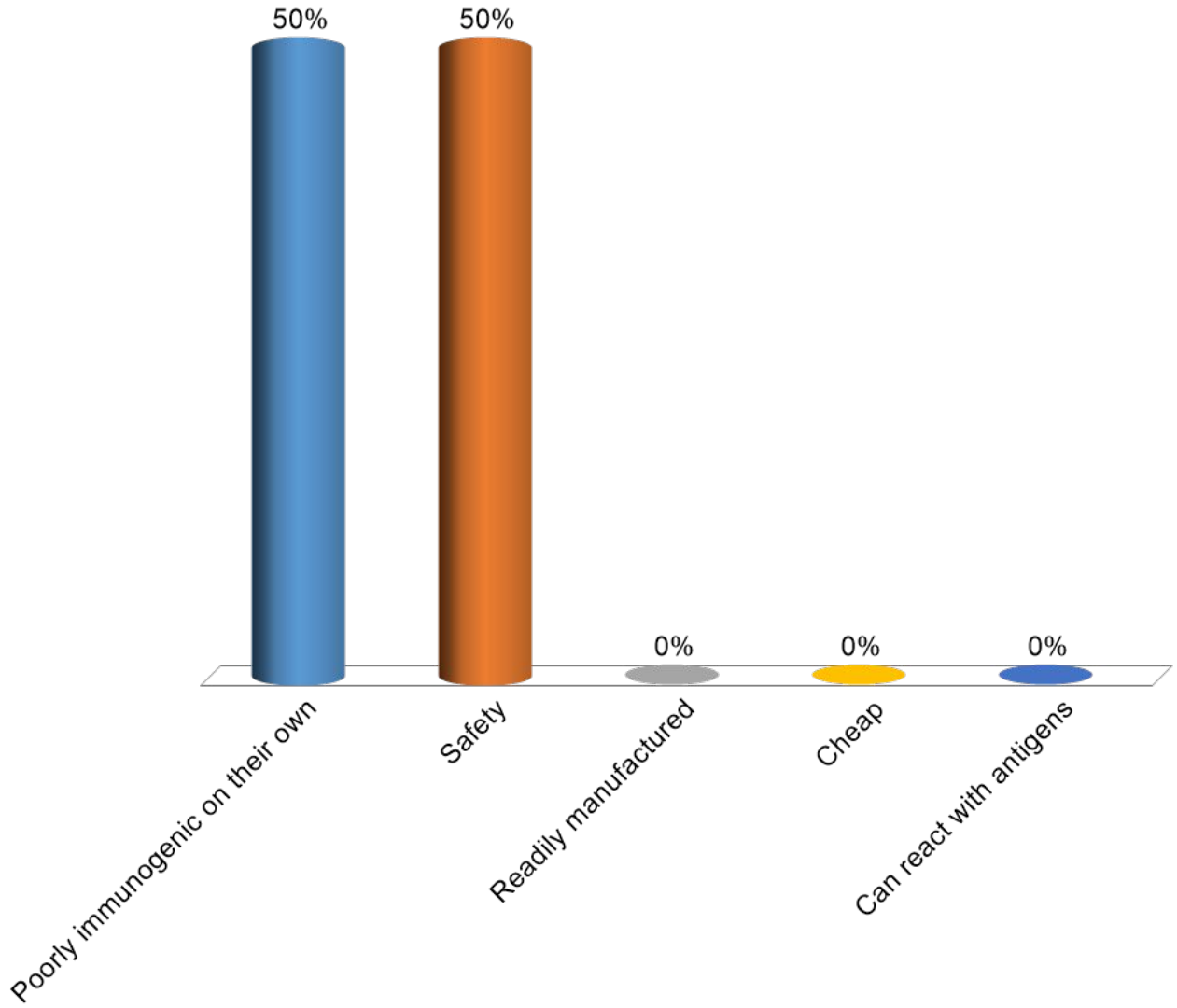


Chem. Rev. **115**, 11109-11146 (2015)

Abbas, A. K.,et al. *Cellular and Molecular Immmnology*

6. What are the characteristics of currently licensed adjuvants?

- ✓ A. Poorly immunogenic on their own
- B. Safety
- ✓ C. Readily manufactured
- ✓ D. Cheap
- E. Can react with antigens



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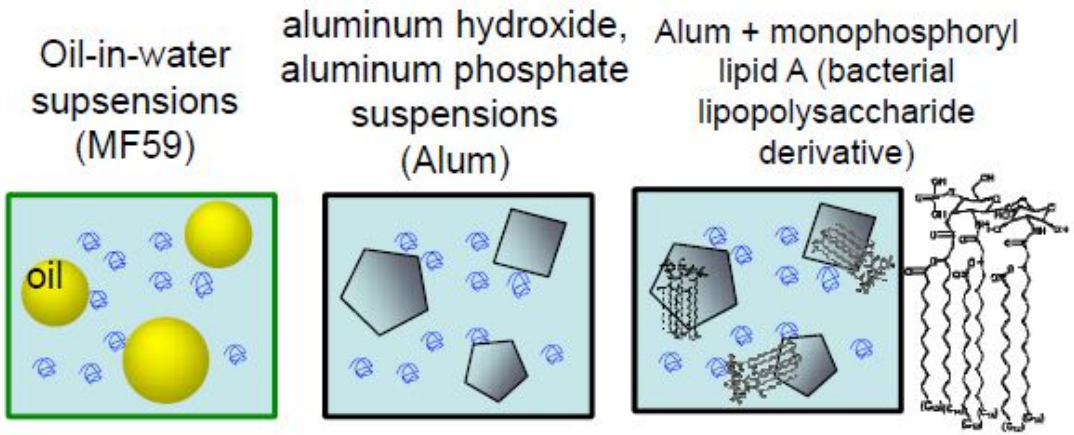

- **Poorly immunogenic on their own**
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Existing adjuvants:

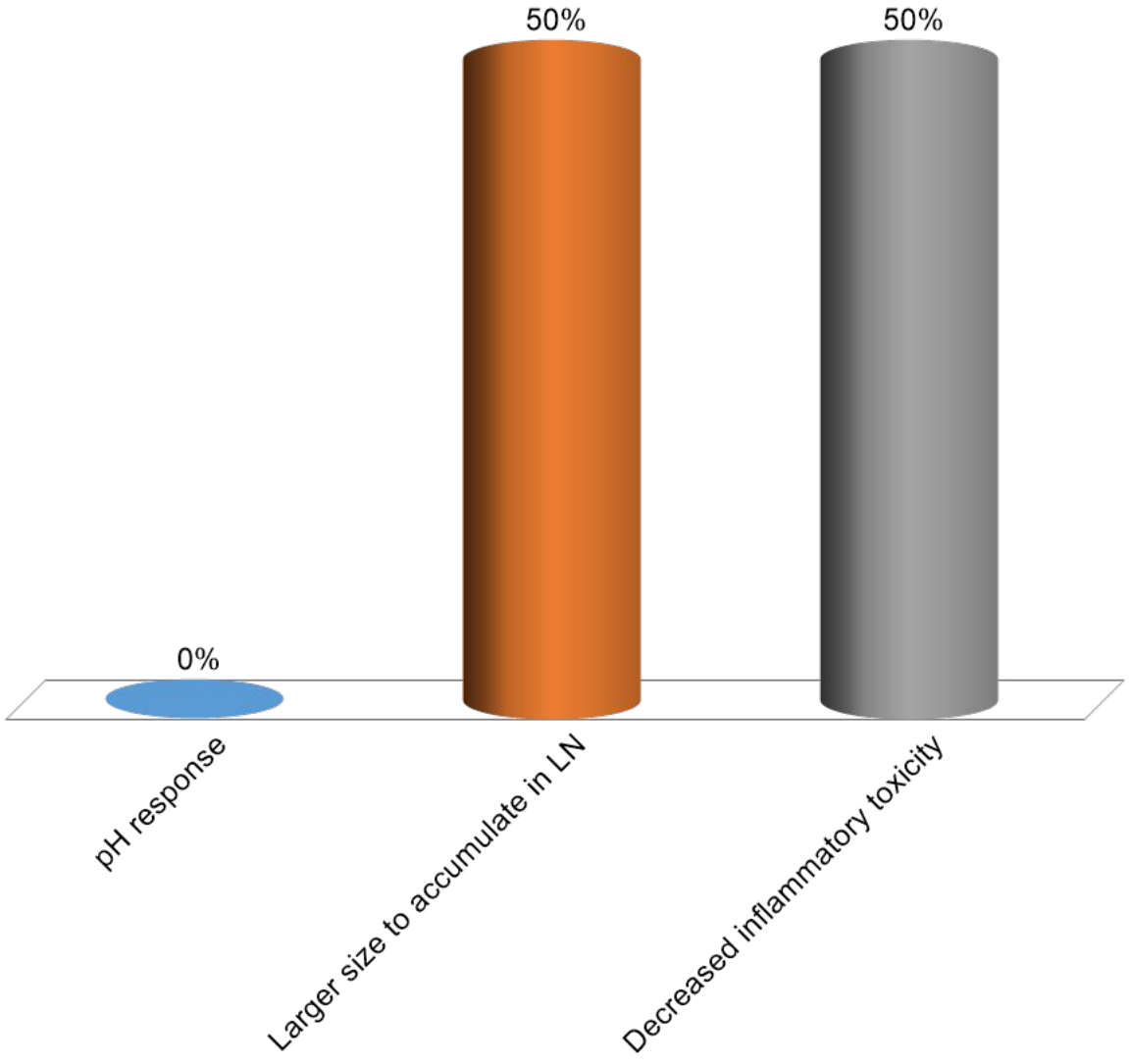
- increase humoral response, but weak cellular responses and little or no CD8+ T-cell response
- Th2 bias to immune response - not the most effective for intracellular pathogens or cancer
- poor durability of immune response

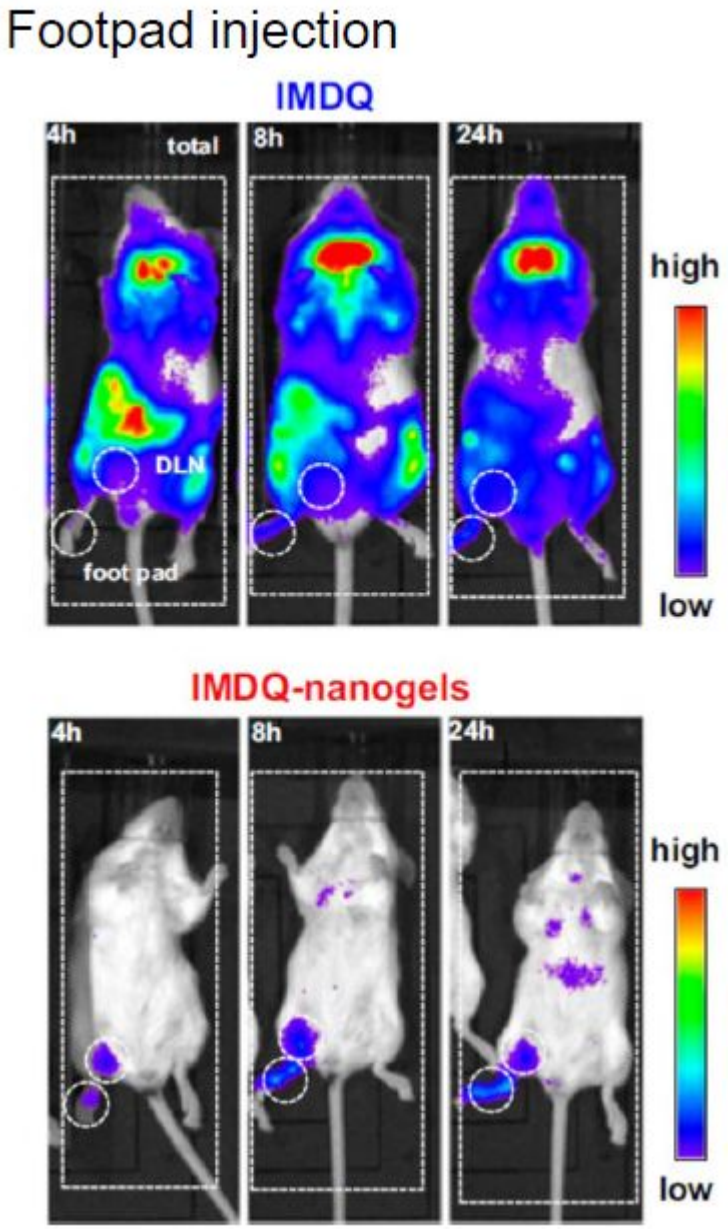
7. Compared with free IMDQ (TLR7/8 agonist), what are the advantages of IMDQ nanogels?

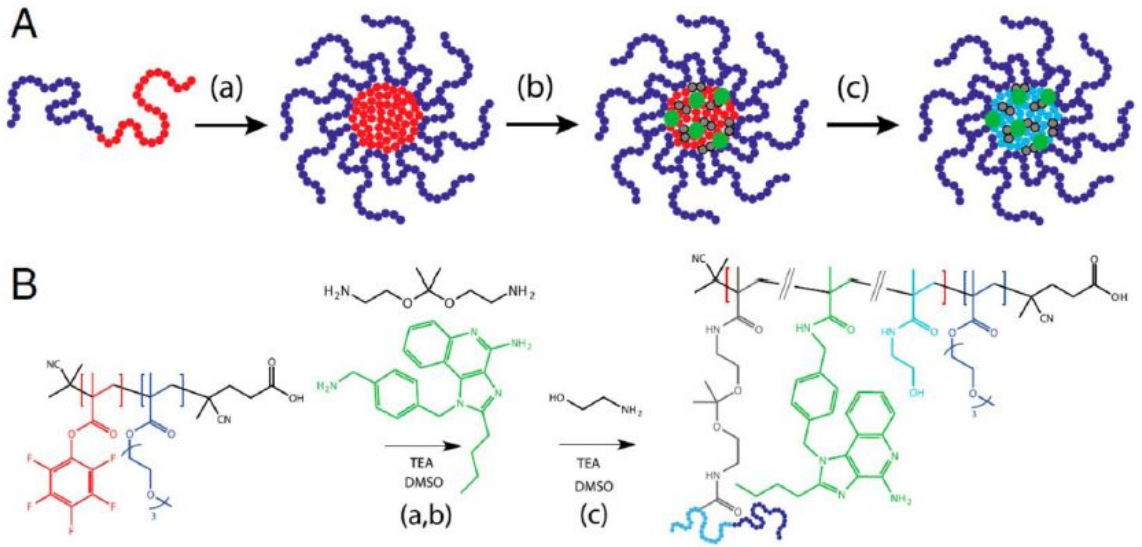
A. pH response ✓

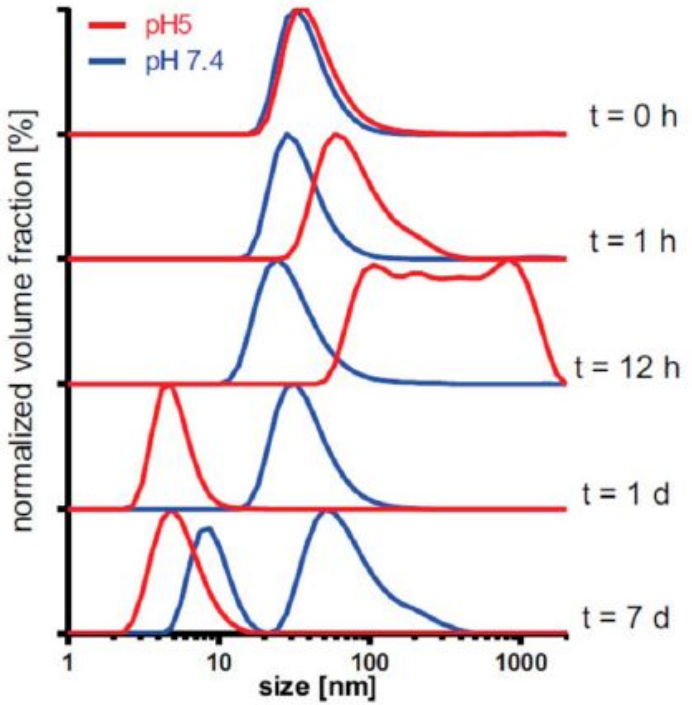
B. Larger size to accumulate in LN ✓

C. Decreased inflammatory toxicity ✓







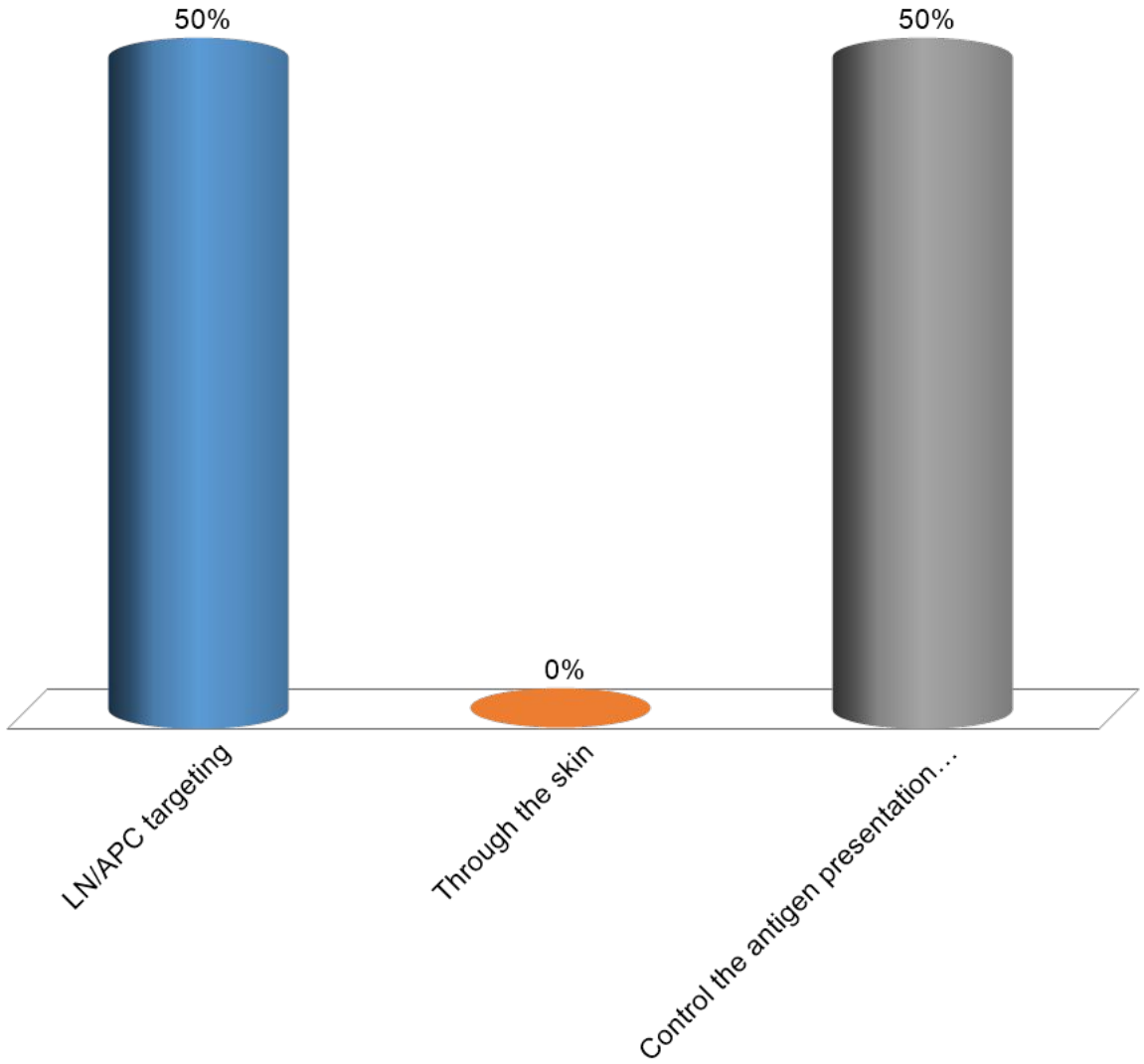


nanogels
with similar size around 50 nm
nanogels readily swell in
response to acidic medium and
fully degrade

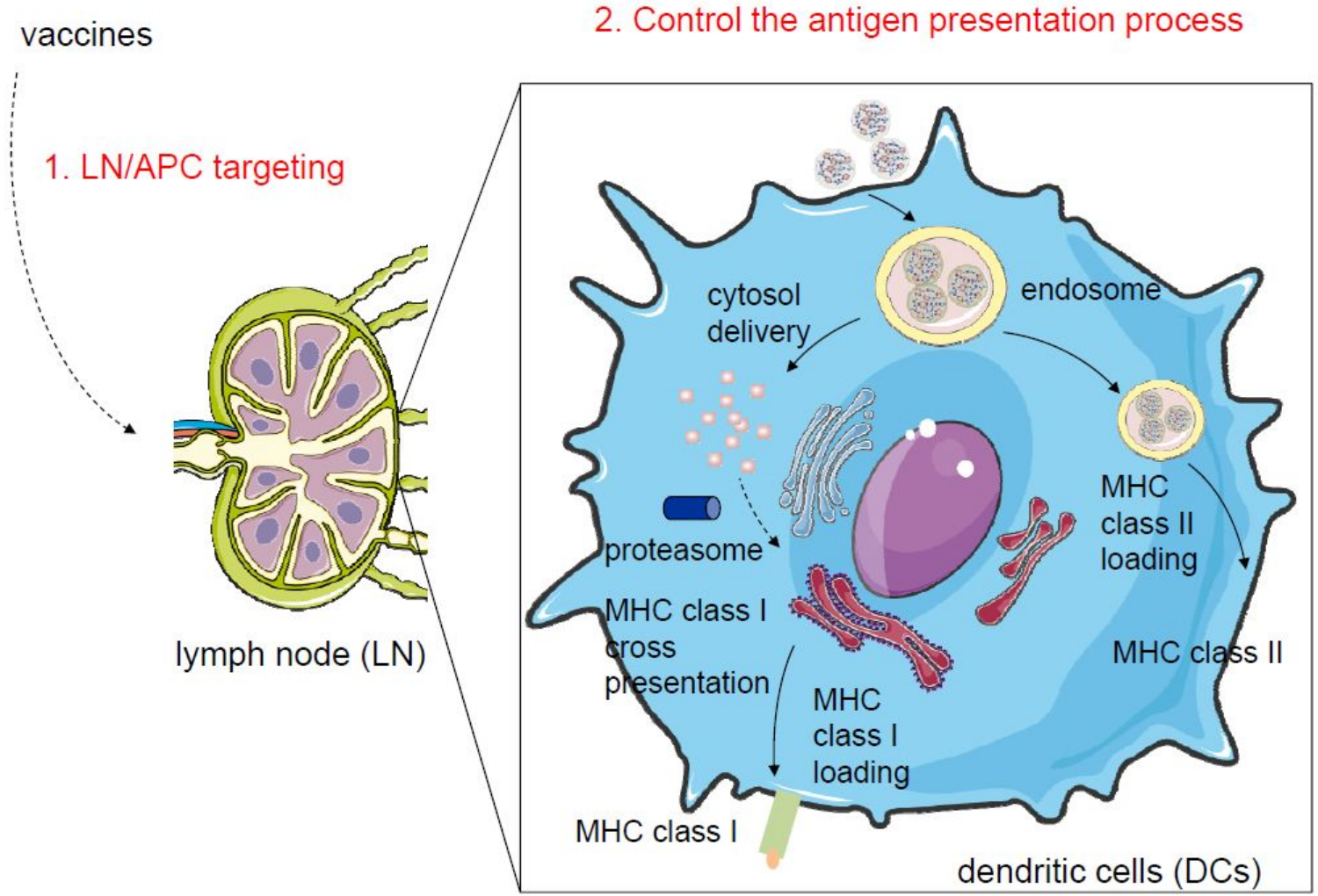
Proc. Natl. Acad. Sci. **2016,** *113*, 8098-103.

8. To achieve an effective vaccine, what are the characteristics that the vaccine should possess?

- ✓ A. LN/APC targeting
- B. Through the skin
- ✓ C. Control the antigen presentation process



To achieve an effective vaccine



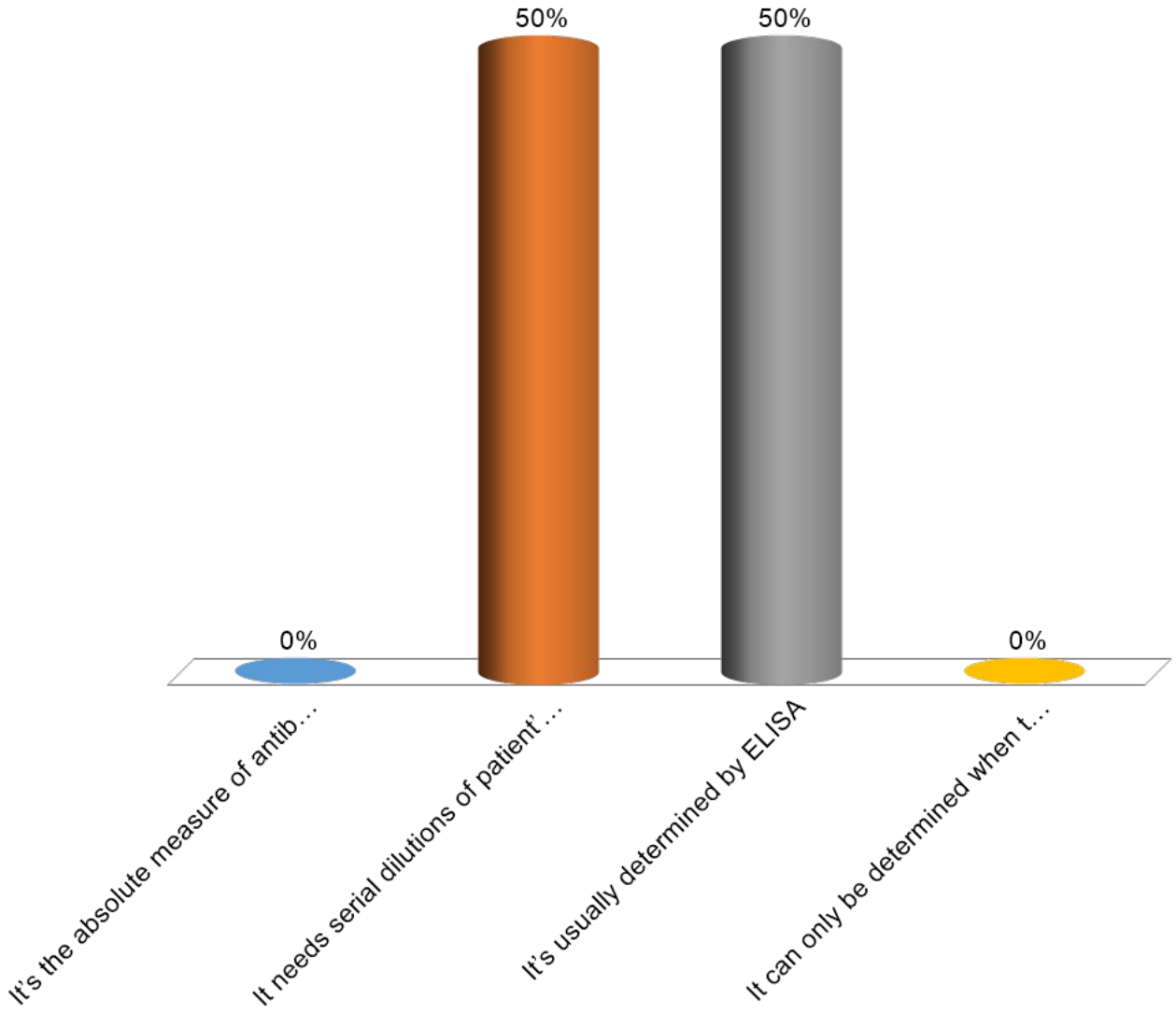
9. Which of the following descriptions regarding antibody titer are correct?

A. It’s the absolute measure of antibody concentration in the serum

✓ B. It needs serial dilutions of patient’s serum

✓ C. It’s usually determined by ELISA

D. It can only be determined when the antigen is known



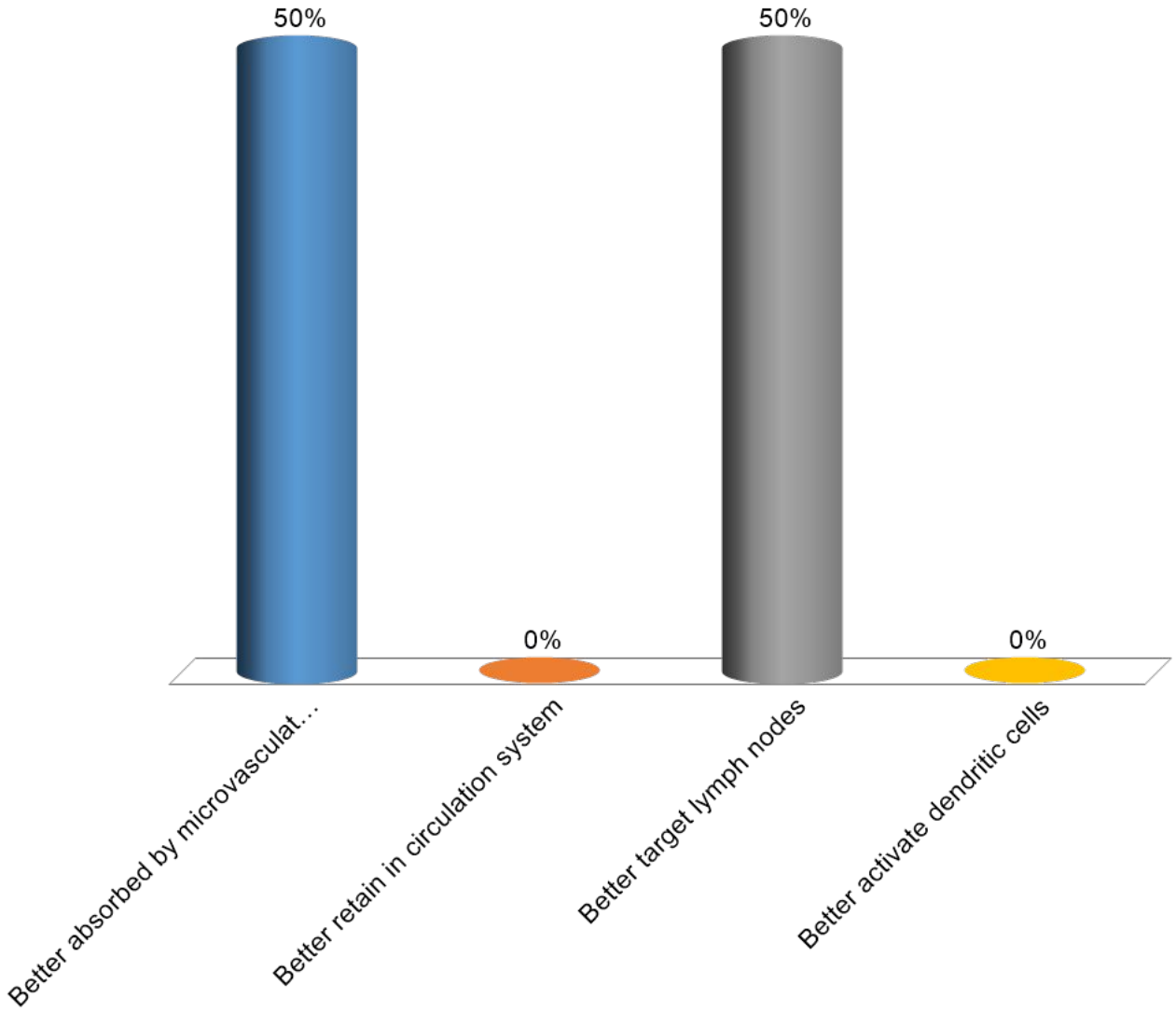
10. What are the advantage of albumin hitchhiking vaccine?

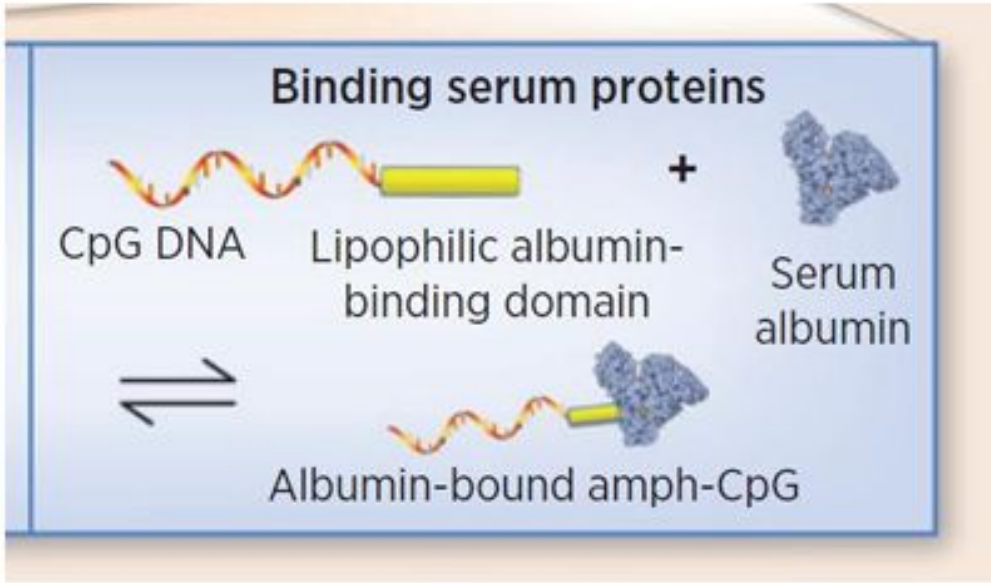
A. Better absorbed by microvasculature

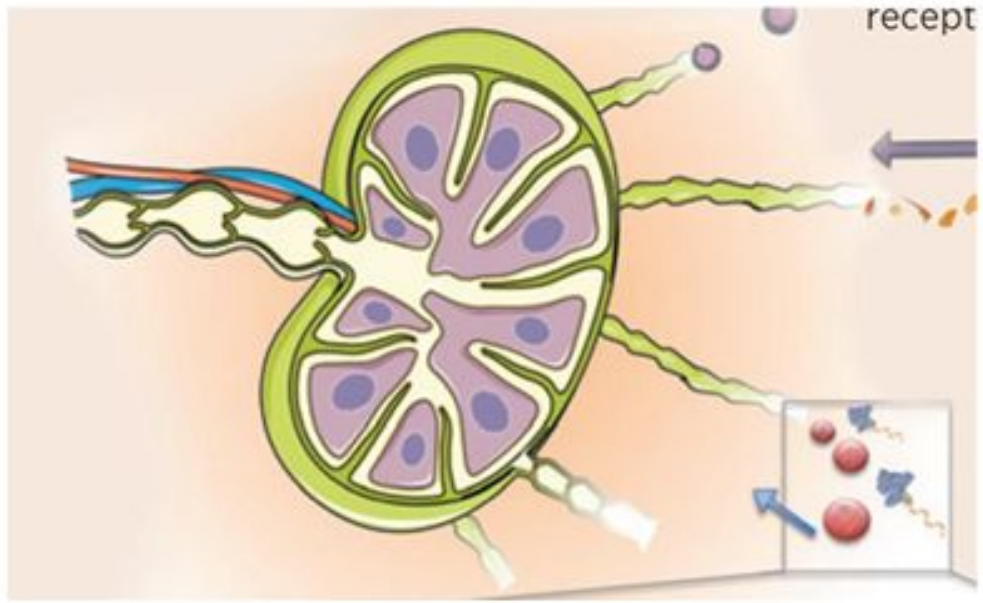
B. Better retain in circulation system

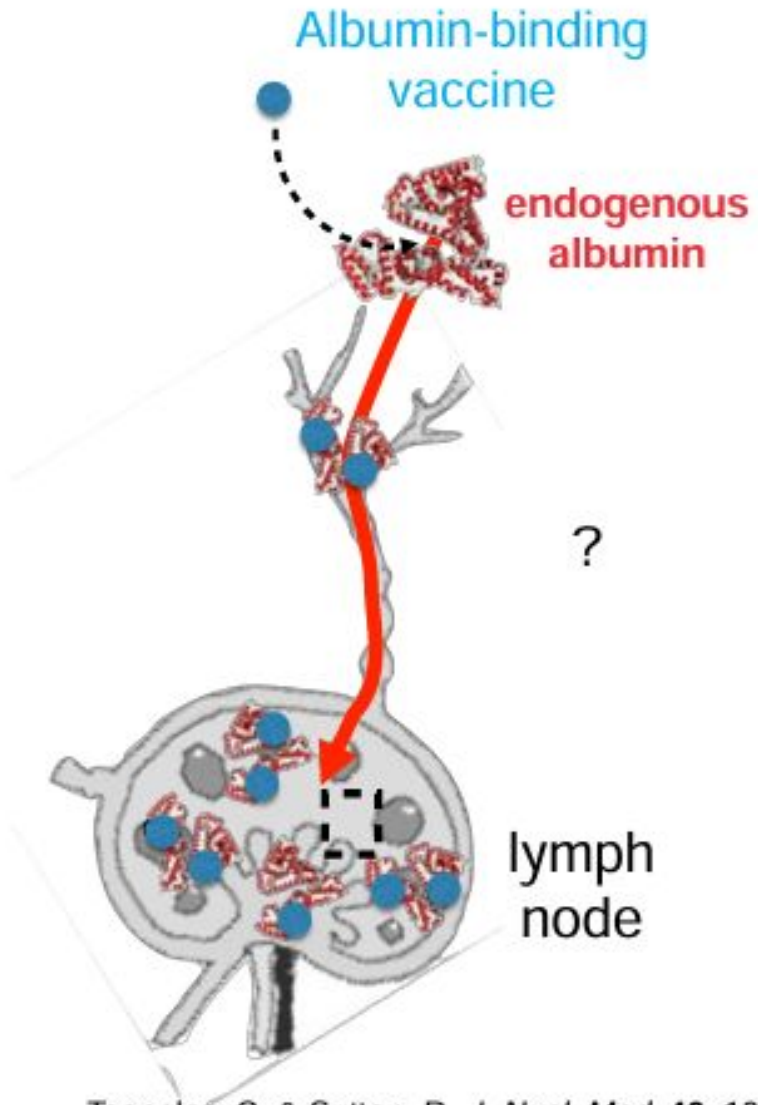
✓ C. Better target lymph nodes

✓ D. Better activate dendritic cells









Tsopelas, C. & Sutton, R. *J. Nucl. Med.* **43**, 1377–1382 (2002);
Faries, M. B. *et al. Ann. Surg. Oncol.* **7**, 98–105 (2000).

Saha, S. *et al. Am. J. Surg.* **191**, 305–310 (2006)