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Viral and Non viral Drug Delivery Systems

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Content

01 **Background**

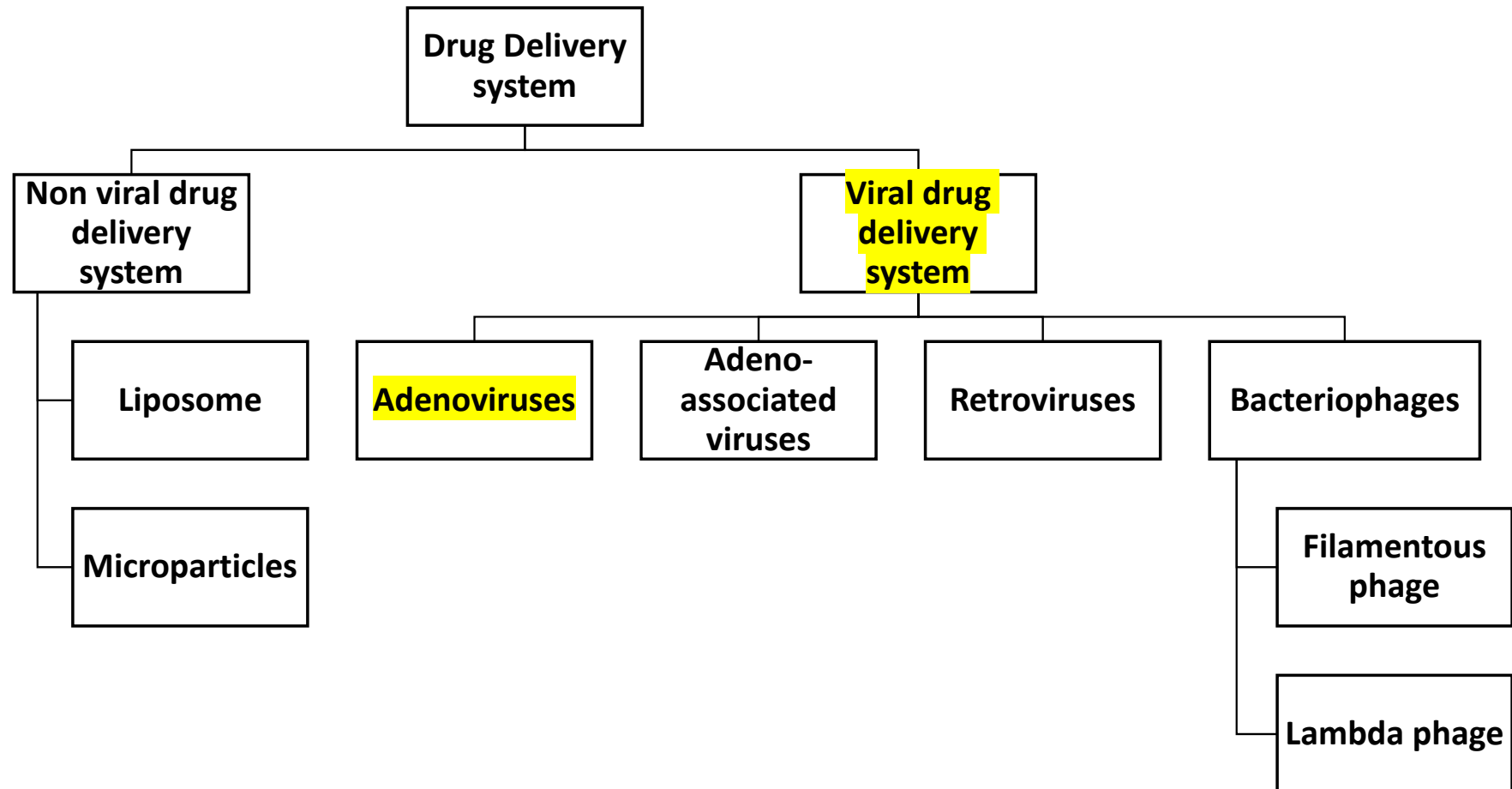
02 **Viral drug delivery system**

03 **Non viral drug delivery system**

04 **Conclusion**



Background





Viral Drug Delivery Systems

1. Adenovirus

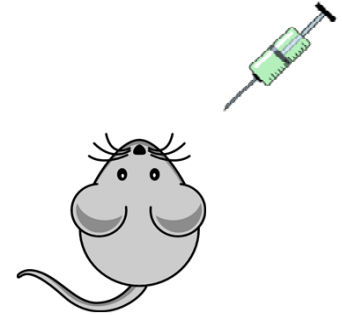
Double-stranded DNA

Entities with icosahedral nucleocapsids

Application:

1. Muscular disorders

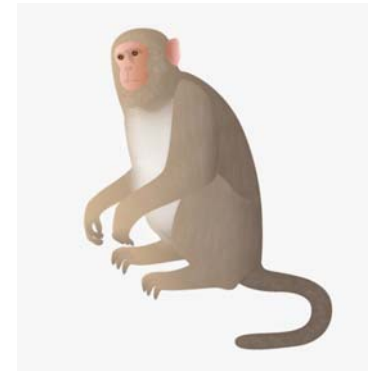
Widespread long-term gene transfer throughout mouse skeletal and cardiac muscles
By intravenous administration of recombinant adenovirus



2. COVID-19 vaccine

Constructed adenovirus serotype 5 that carries a codon-optimized gene encoding the full-length SARS-CoV-2 S protein (Ad5-S-nb2). They can efficiently express SARS-CoV-2 S protein in infected cells

At 30 days after a single vaccination with Ad5-S-nb2 either intramuscularly or intranasally, macaques are protected against SARS-CoV-2 challenge

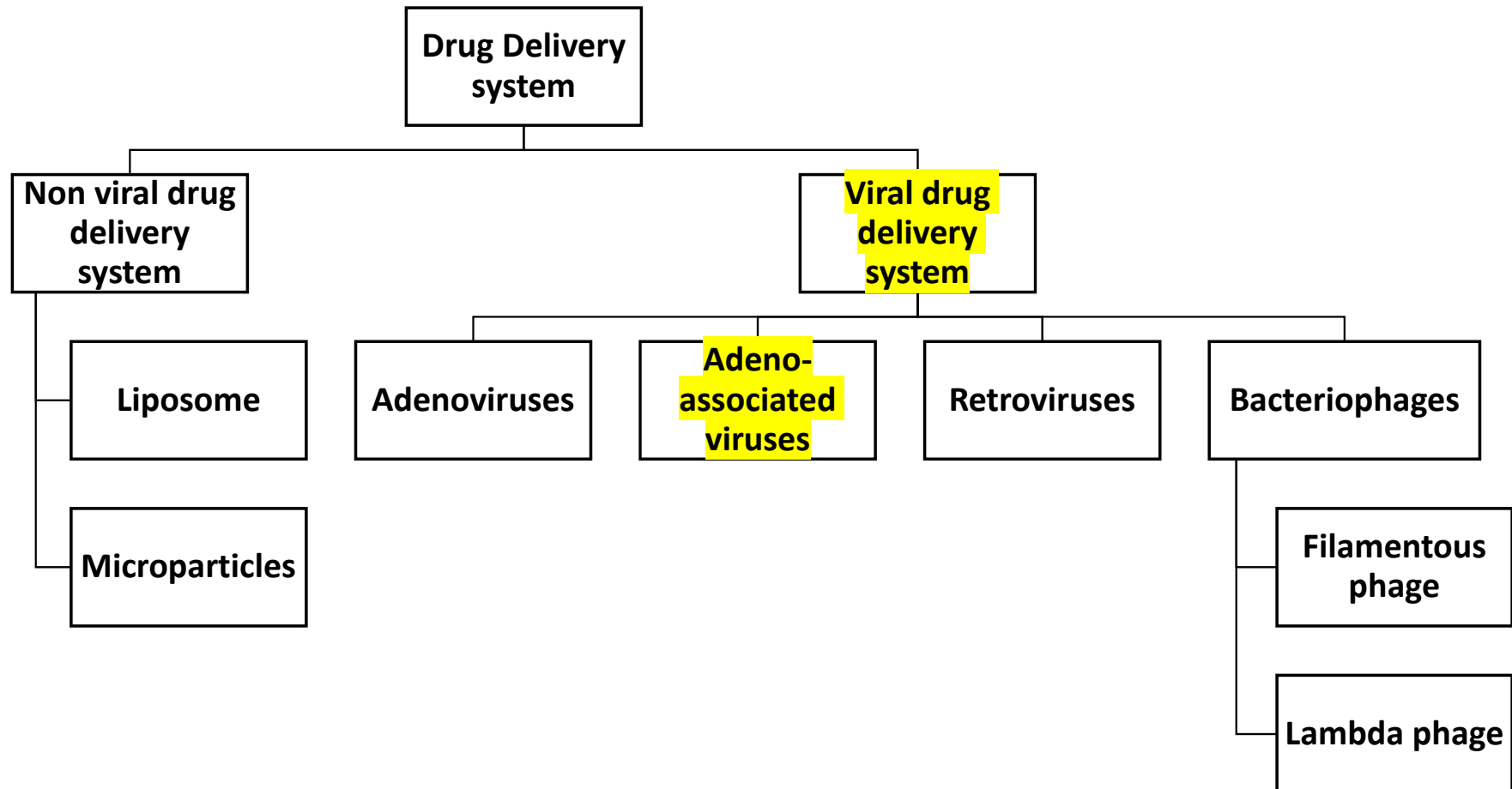


Feng, L., et al. *Nat Commun* 2020.

Stratford-Perricaudet, L. D., et al. *The Journal of clinical investigation* 1992



Background



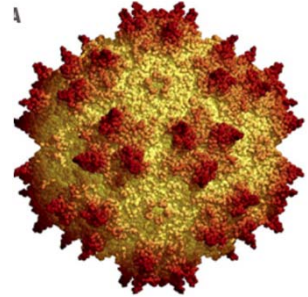


Viral Drug Delivery Systems

2. Adeno associated virus (AAV)

Single stranded DNA

AAV has emerged as the most **predominantly** used viral vector for gene-based therapies

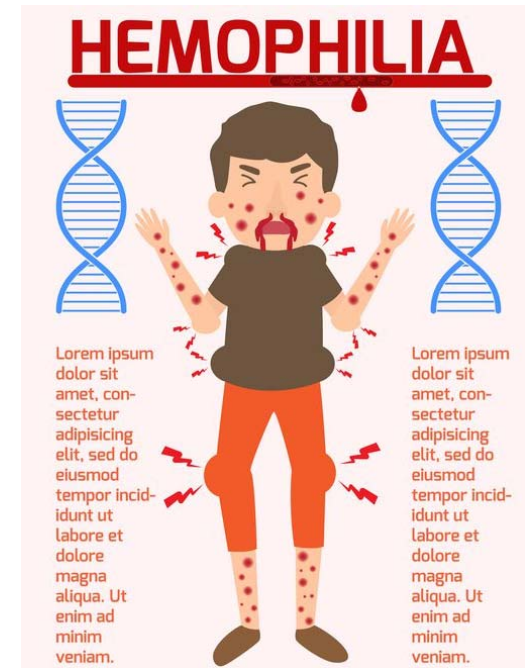


Application:

Hemophilia B (HB)

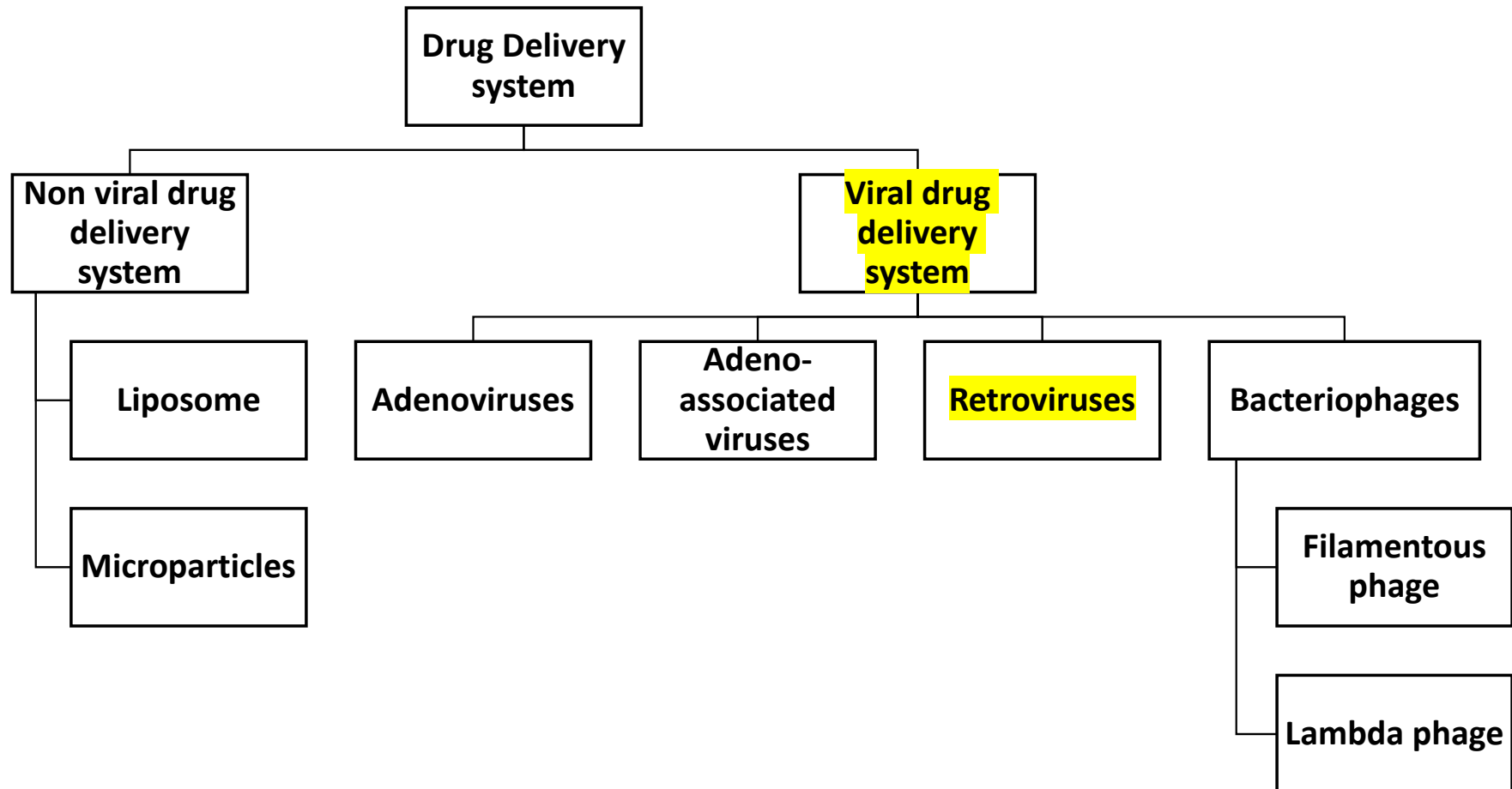
Intravenous infusion of a novel serotype 8 pseudotyped, self-complementary AAV (AAV8) vector expressing a codon-optimized factor IX transgene.

AAV-mediated expression of FIX at 2 to 11% of normal levels was observed.





Background





Viral Drug Delivery Systems

3. Retrovirus

Two single-stranded RNA

The basic structure of retrovirus also include the *env*, *pol* and *gag*.
Integrating itself with the genome of the host cell DNA

Application

Calvarial bone defects

Implantation of Osx-transduced bone marrow-derived mesenchymal stem cells (BMSCs) resulted in 85% healing of calvarial bone defects as detected using radiological analyses

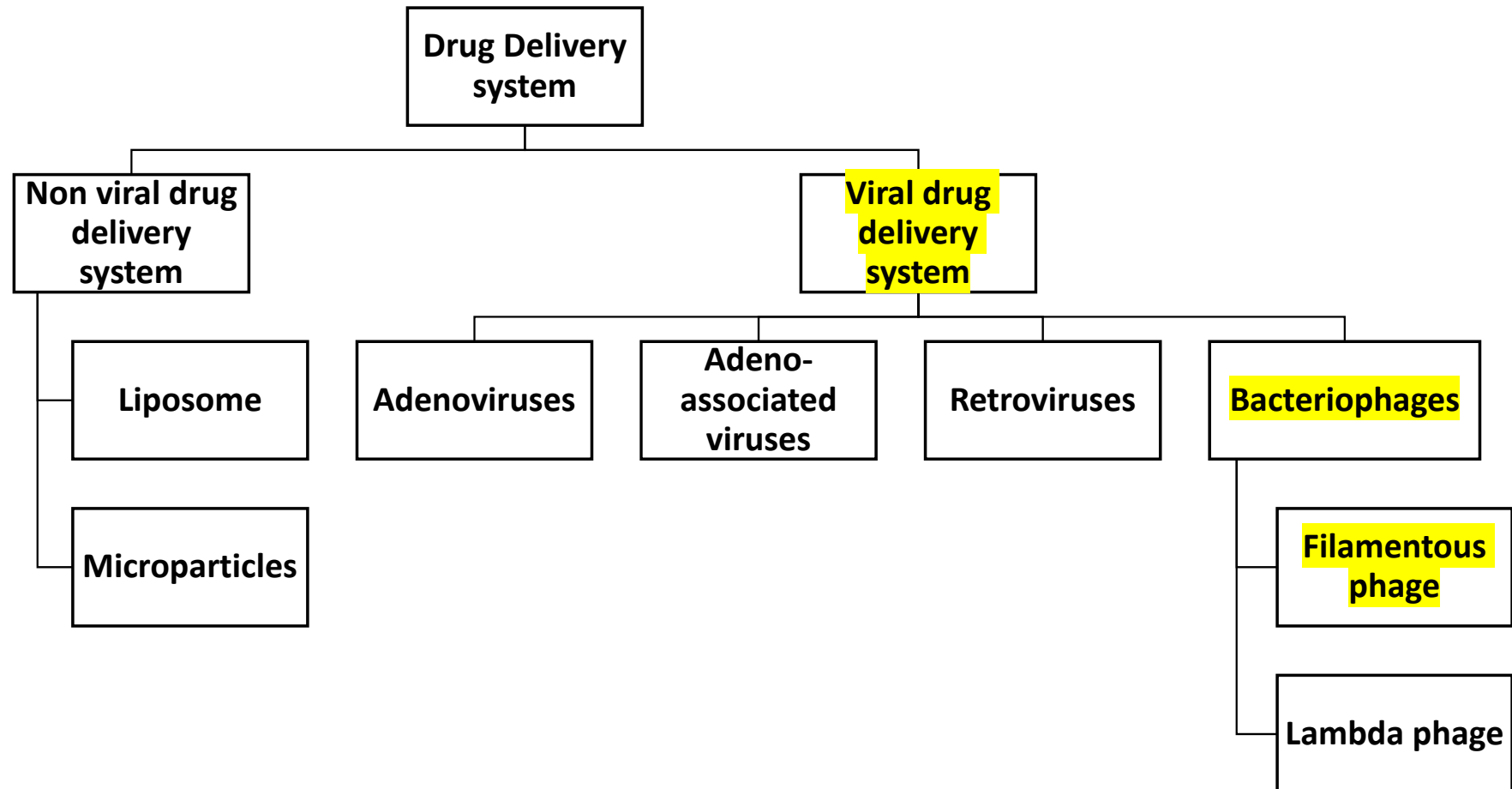
The BMSCs were transduced by avian retroviral receptor (TVA)-based retroviral system



Tu, Qisheng, et al. *Tissue engineering* 2007.



Background





Viral Drug Delivery Systems

4.1 Phage Virus-Filamentous Phage

Single-stranded DNA

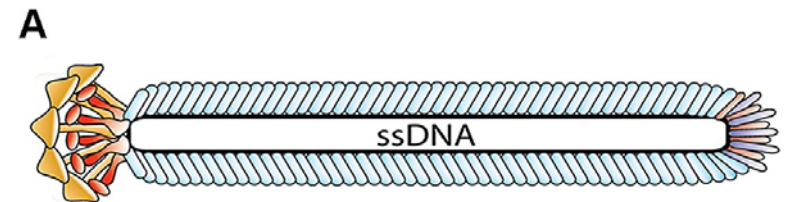
Phage therapy is now seen as a major alternative treatment to the use of antibiotics

The filamentous phages that infect *Escherichia coli* are the most fertile bacteriophages in the nature and are called “Ff phages” (this group is sub-divided into f1, M13 and fd phages)

Application

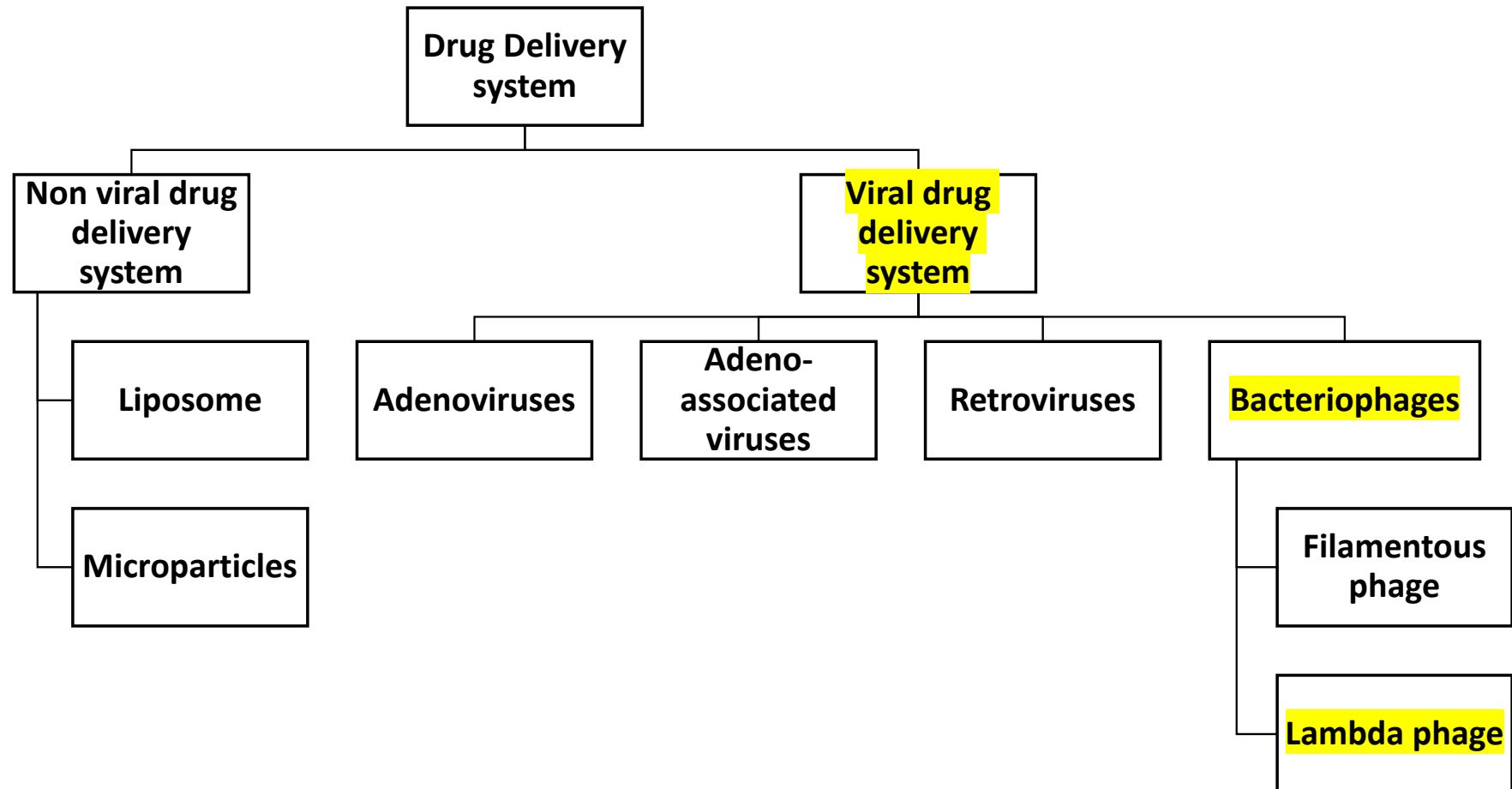
1. Bacterial infection
2. Cancer and chronic diseases
3. Autoantibody-mediated autoimmune conditions.
4. Vaccines against HIV-1

Karimi, Mahdi, et al. *Advanced drug delivery reviews* 2016





Background





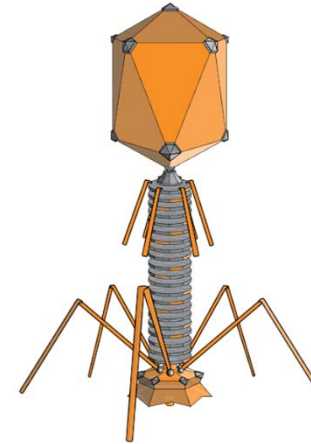
Viral Drug Delivery Systems

4. Phage Virus-Lambda phage

Double-stranded DNA

The structure consists of three main parts

1. The head or capsid (gpD capsid protein; dsDNA sequence)
2. Tail
3. Tail nanofibers



Application

HPV-associated cancers

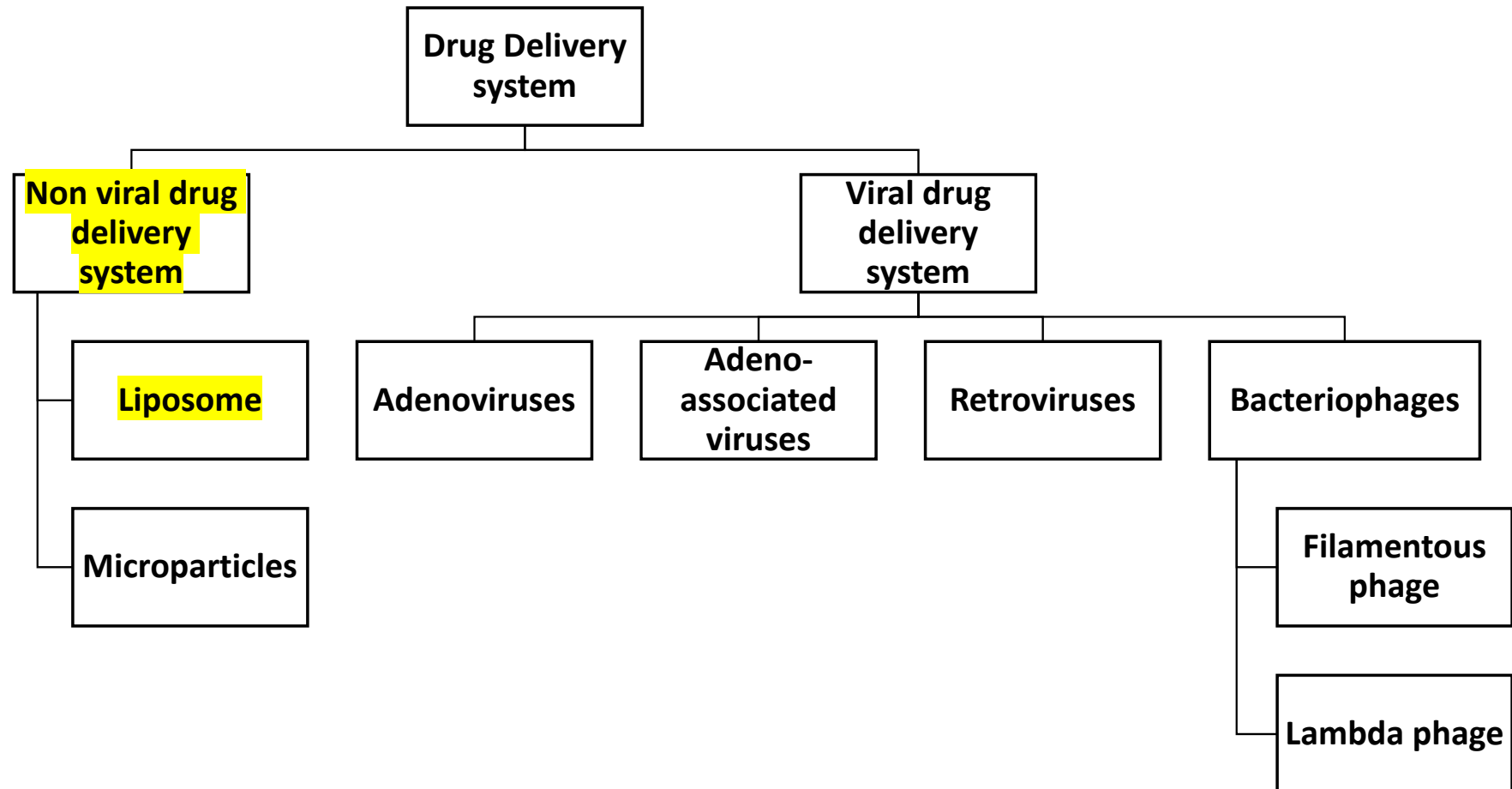
Constructing lambda-ZAP-CMV vector encoding GFP and E7 gene of human papilloma virus (HPV)

Enhance anti-tumor immune response against HPV-expressing cancers

Ghaemi, Amir, et al. *Genetic vaccines and therapy* 2010



Background





Non-Viral Drug Delivery Systems

1. Liposomes

Spherical vesicle having at least one lipid bilayer

Advantage:

They are capable of housing both hydrophilic and lipophilic compound without being destabilized

Application:

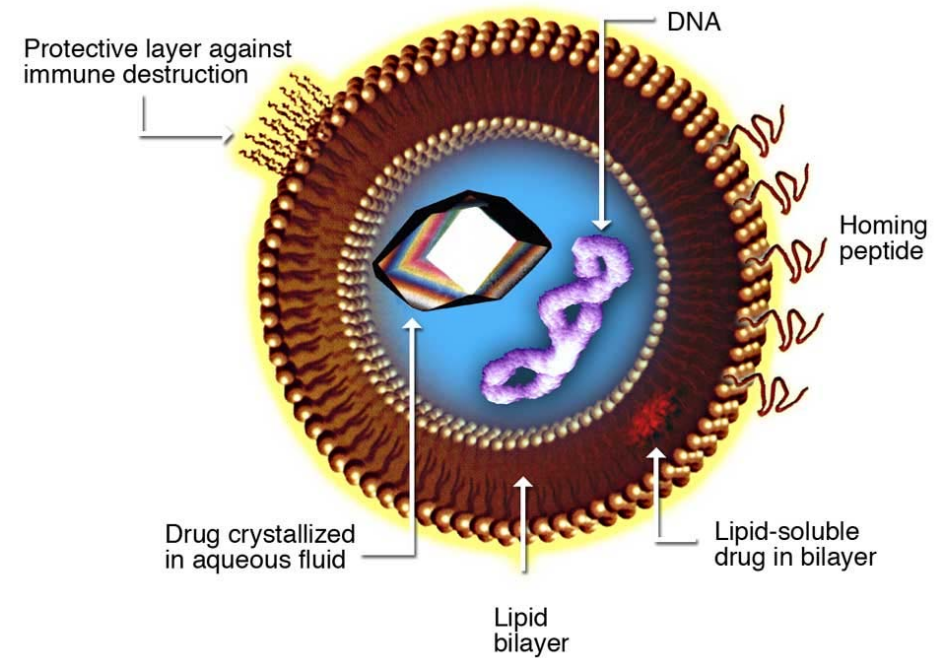
Against solid tumors.

L-BLP25 peptide for **lung carcinoma**

Irinotecan (MM-398) for **pancreatic cancer**

and cisplatin (Lipoplatin) for **ovarian cancers**

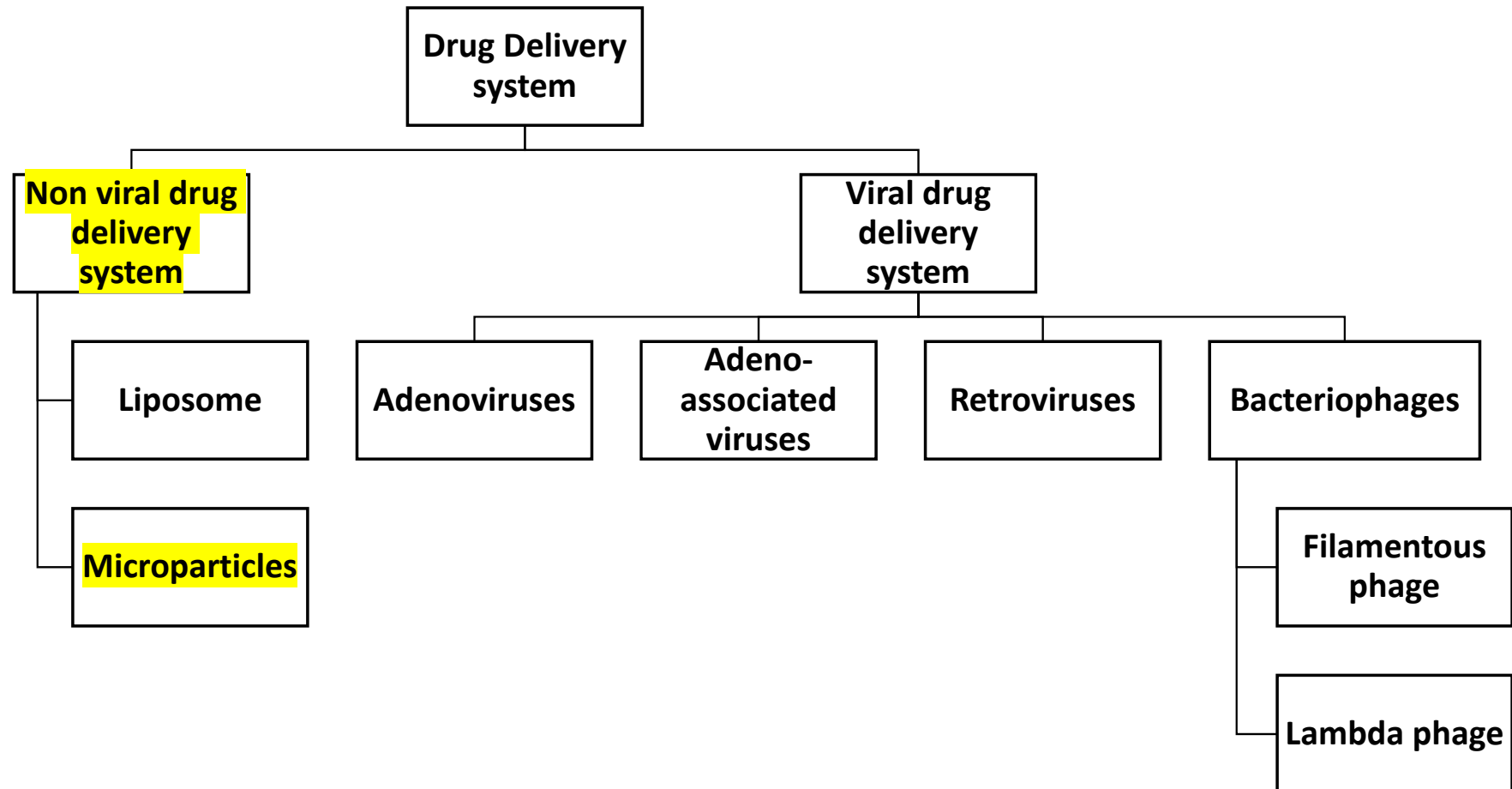
Liposome for Drug Delivery



Torchilin, V *Advanced Drug Delivery Reviews*. 2006



Background





Non-Viral Drug Delivery Systems

2. Microparticles

1 to 1000 μm

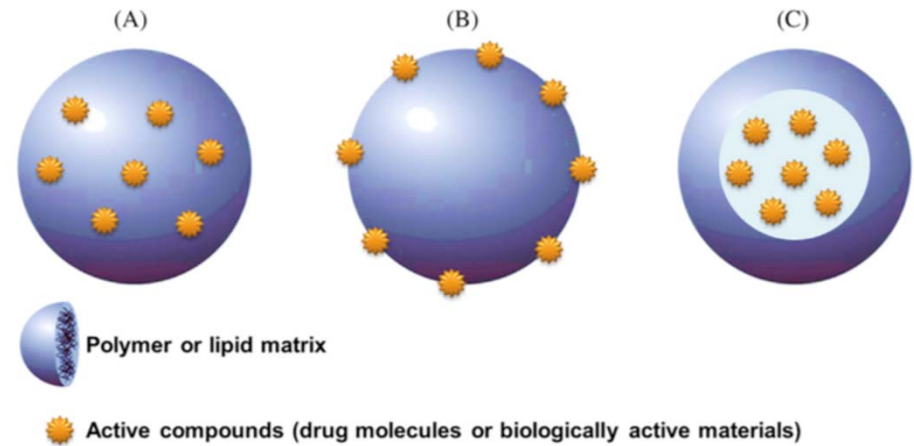
Polymeric microparticles (p-MPs)

Deliver hydrophilic and hydrophobic drugs

Application:

1. Inflammatory bowel diseases (IBD)

2. Lung cancer



Schematic representation of microparticles carrying active compounds (A) within its matrix, (B) on its surface, and (C) in its internal cavity (particles with core-shell structures).

Vilos, C, et al. *Journal of Biomedicine and Biotechnology* 2012



Conclusion

	Type of virus	Carrying molecule/complex	Application	Pros	Cons
Viral drug delivery system	Adenovirus	Spike protein	Muscular disorders /COVID-19 vaccine	Well-characterized genome	High level of immunogenicity
	AAV	ANF /FIX	Atrial diseases/HB	Low immune response	Limited cloning capacity
	Retrovirus	Osterix	Calvarial bone defects	Integrate into the target cell genome	Insertional mutagenesis
	Phage Virus	GFP and E7	HPV-associated diseases	Versatility	High level of immunogenicity
Non viral drug delivery system	Liposome	Hydrophilic, lipophilic drugs	Solid tumors	Low immunogenicity	High cost
	Microparticles	Hydrophilic and hydrophobic drugs	IBD/Lung cancer	Better stability	High shear required



Thank you for your listening!
