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Extracellular vesicles from *Staphylococcus aureus* follow different pathways to manipulate host cells

Julia Papail, Ligia Prado, Nathalie Daniel, Brenda Silva Rosa da Luz, Daniele Vassaux, Yann Le Gouar, Nadia Berkova, Julien Jardin, Svetlana Chabelskaia, Yves Le Loir, et al.

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Extracellular vesicles from *Staphylococcus aureus* follow different pathways to manipulate host cells

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MICROBES 2023, 18^e Congrès National de la SFM
Rennes, 05/10/2023



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Société Française
de Microbiologie

MICROBES 2023

18^e CONGRÈS NATIONAL DE LA SFM

4-6
octobre

LE COUVENT
DES JACOBINS

CENTRE DES CONGRÈS DE
DE RENNES MÉTROPOLE

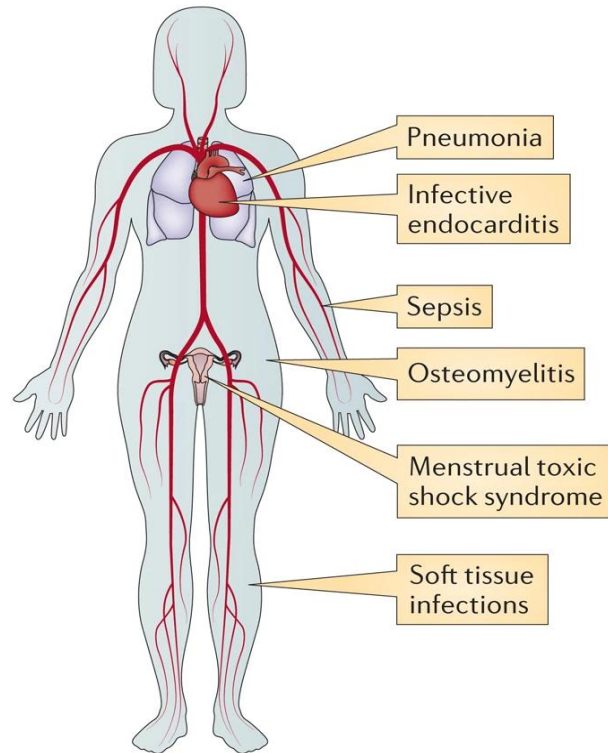


Conflict of interest declaration

For this presentation,
I declare that I have no conflict of interest.

✓ *Staphylococcus aureus*

➤ Human opportunist pathogen



Diseases caused by *Staphylococcus aureus*
Salgado-Pabón W and Schlievert P., 2014

➤ Significant impact on the veterinary medicine and food fields → Etiological agent of mastitis

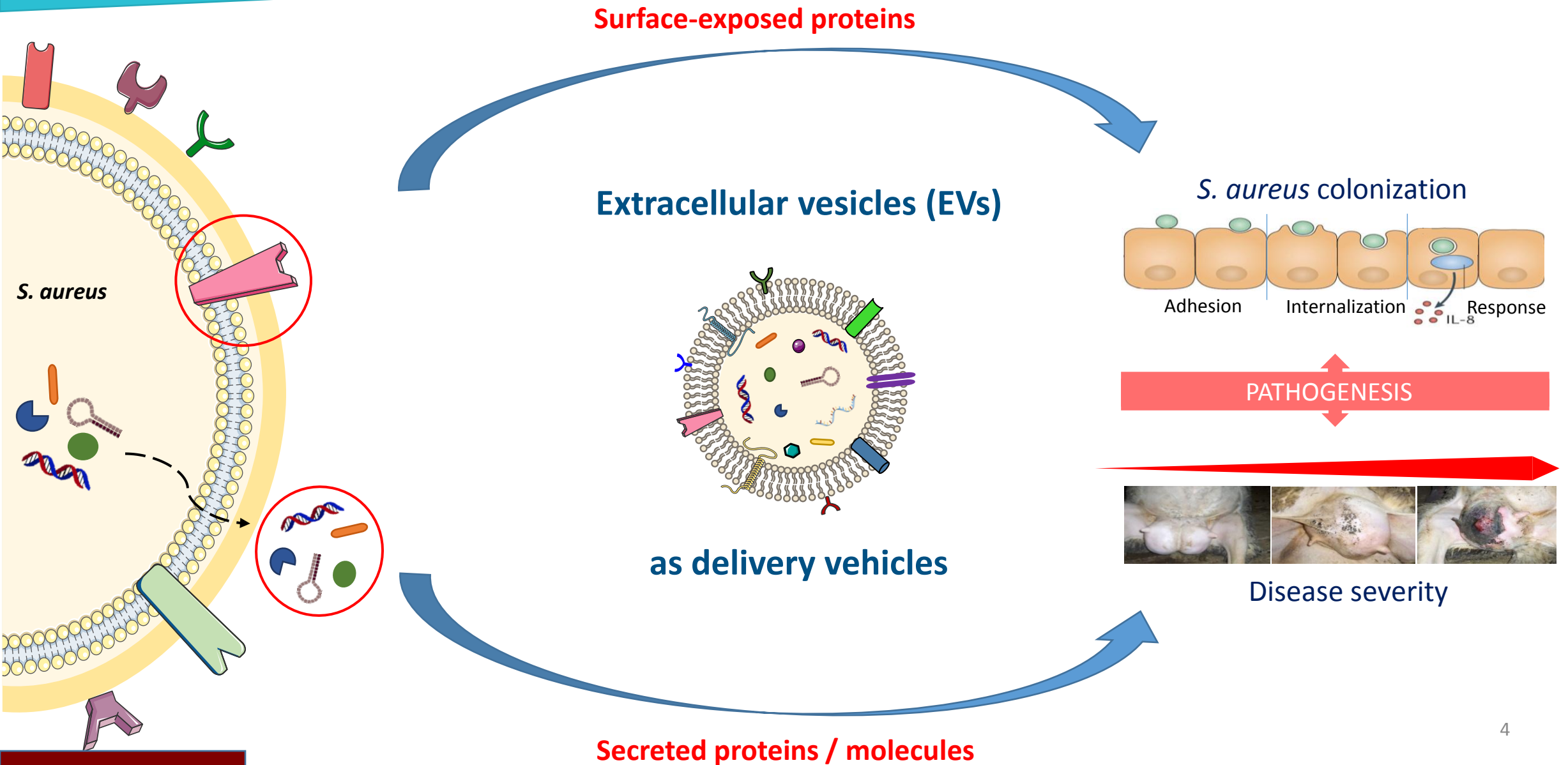


➤ The six highly virulent and antibiotic resistant bacterial pathogens

ESKAPE

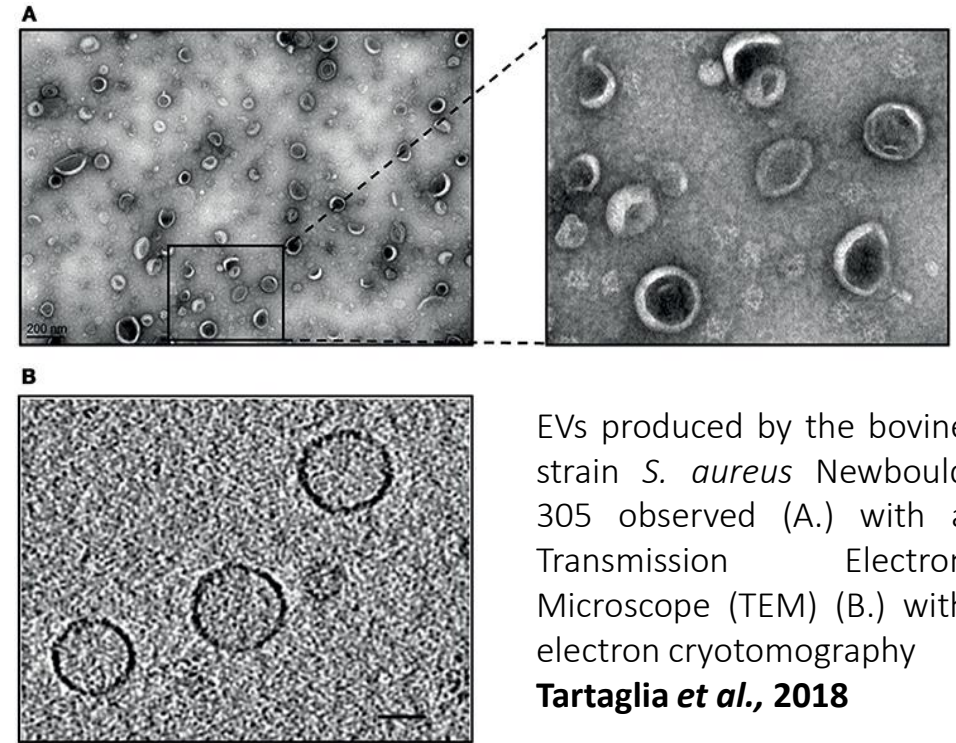


✓ *Staphylococcus aureus* virulence factors



✓ Extracellular vesicles (EVs)

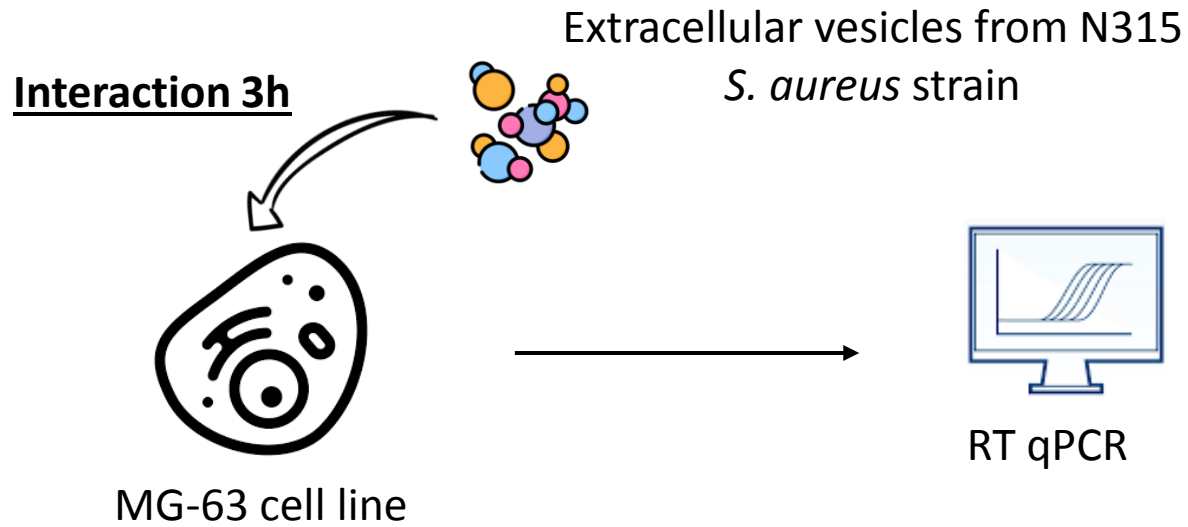
- Lipid bilayer spherical nano-sized particles (30-300 nm) which carry various molecules (eg, lipids, nucleic acids, proteins)
- Vehicles that transport and deliver molecules to local or distant cellular targets
- Imply in cell-to-cell communication and especially in host-pathogen interaction



What is the contribution of extracellular vesicles from *S. aureus* in pathogenesis ?

✓ Role of extracellular vesicles in pathogenesis

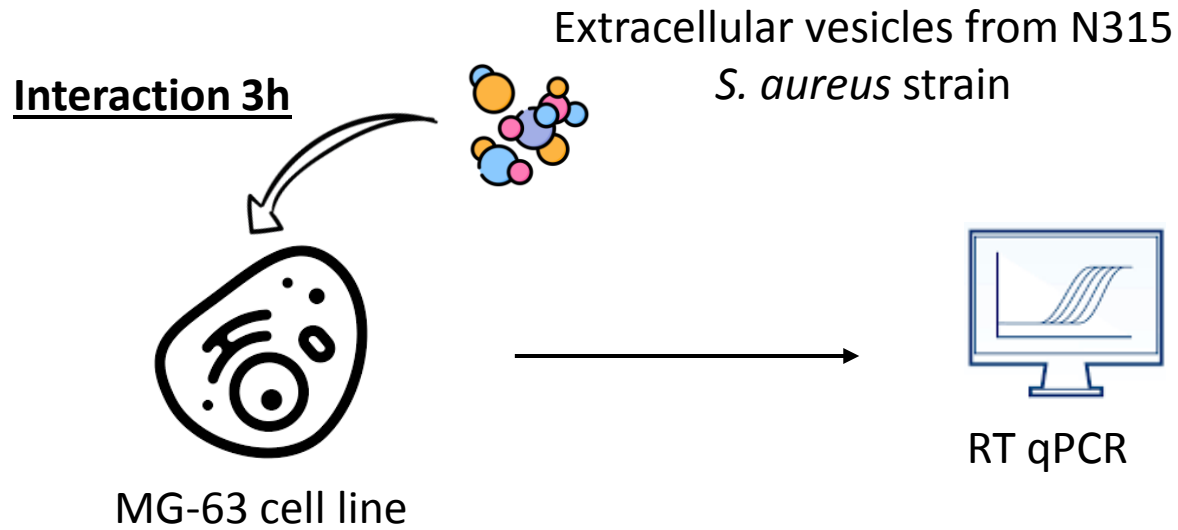
Impact of EVs on the expression of several inflammatory genes



- Human osteoblast-like non-phagocytic cell line
- Taken from patient with osteosarcoma

✓ Role of extracellular vesicles in pathogenesis

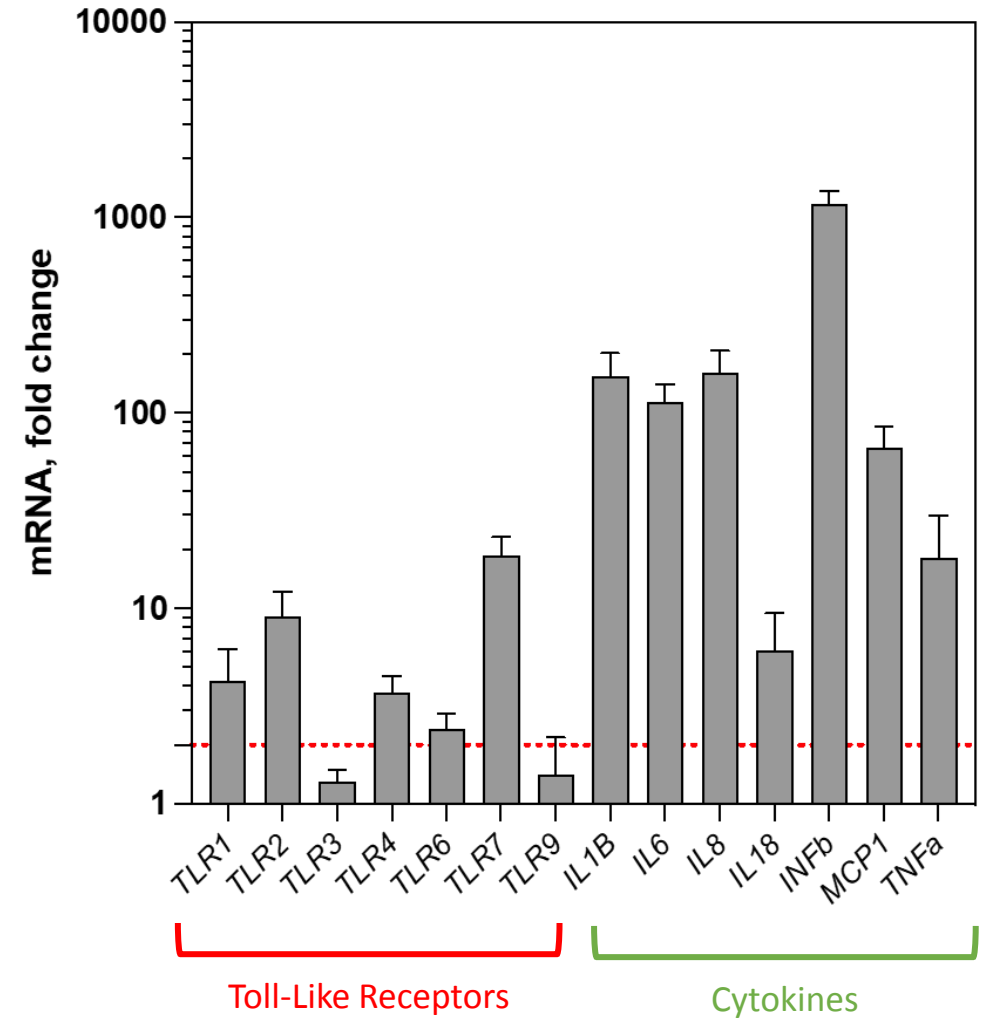
Impact of EVs on the expression of several inflammatory genes



Increased expression of genes coding for :

✓ Cytokines

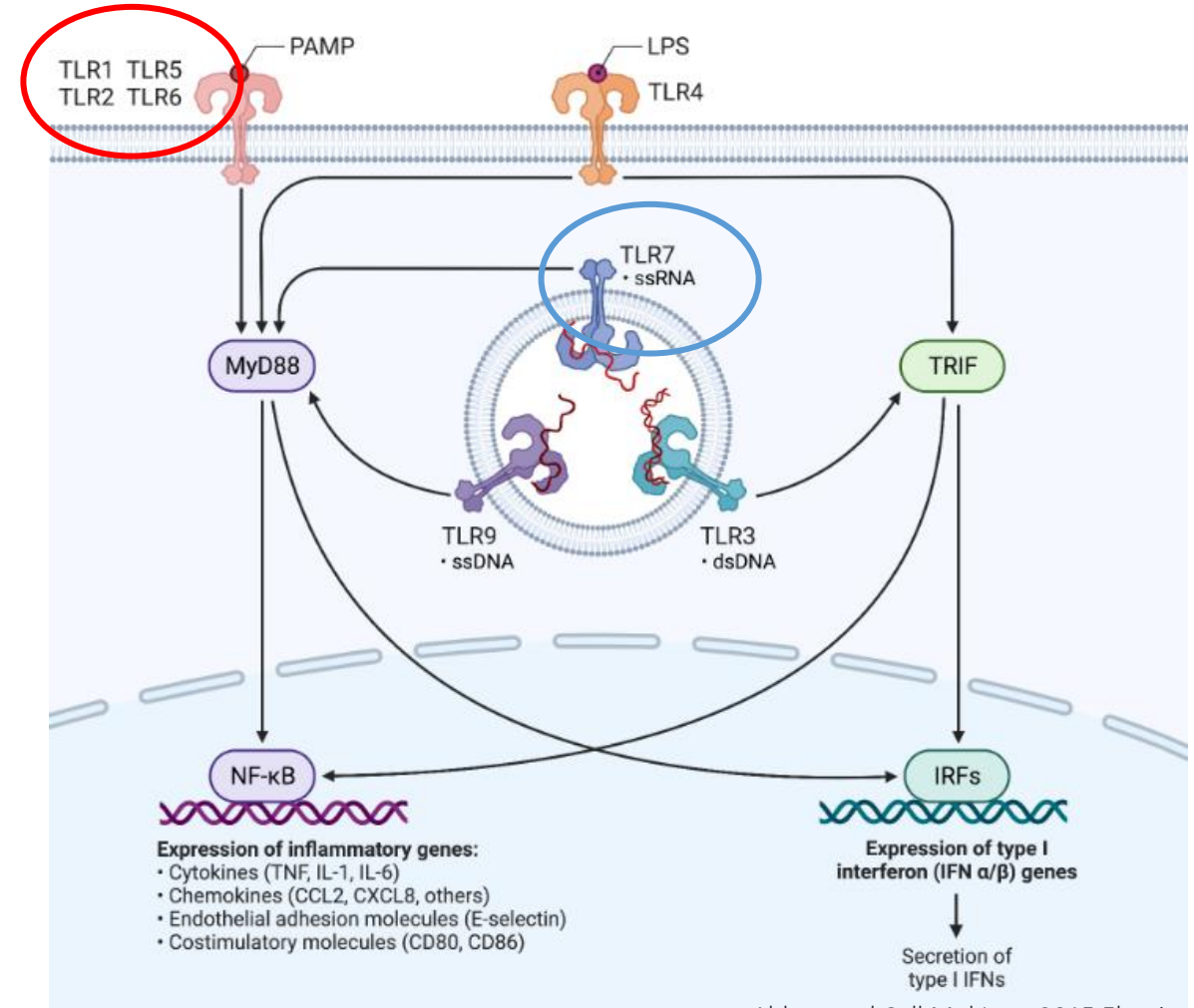
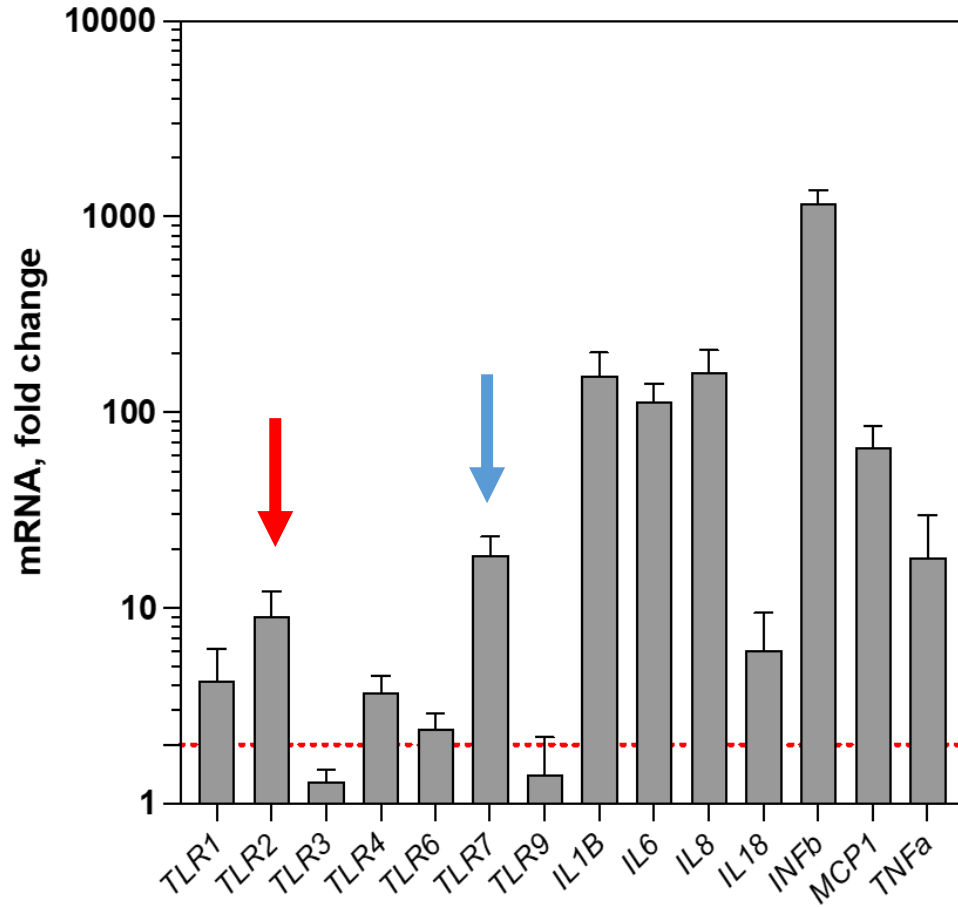
✓ Toll-Like Receptors (TLR)



→ N315-derived EVs induce the expression of various *TLR* and immune genes in MG-63 cells

✓ Role of extracellular vesicles in pathogenesis

Impact of EVs on the expression of several inflammatory genes

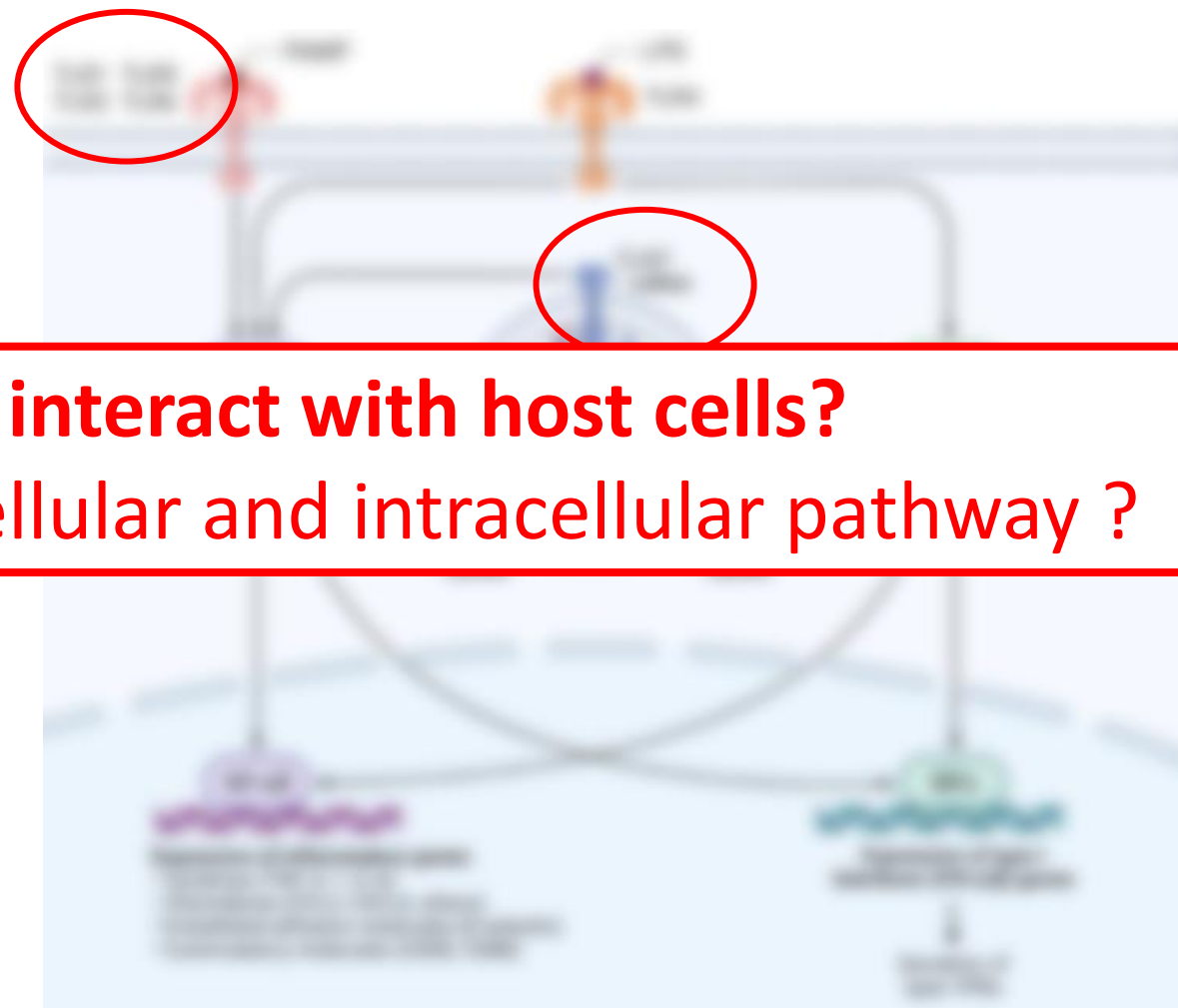
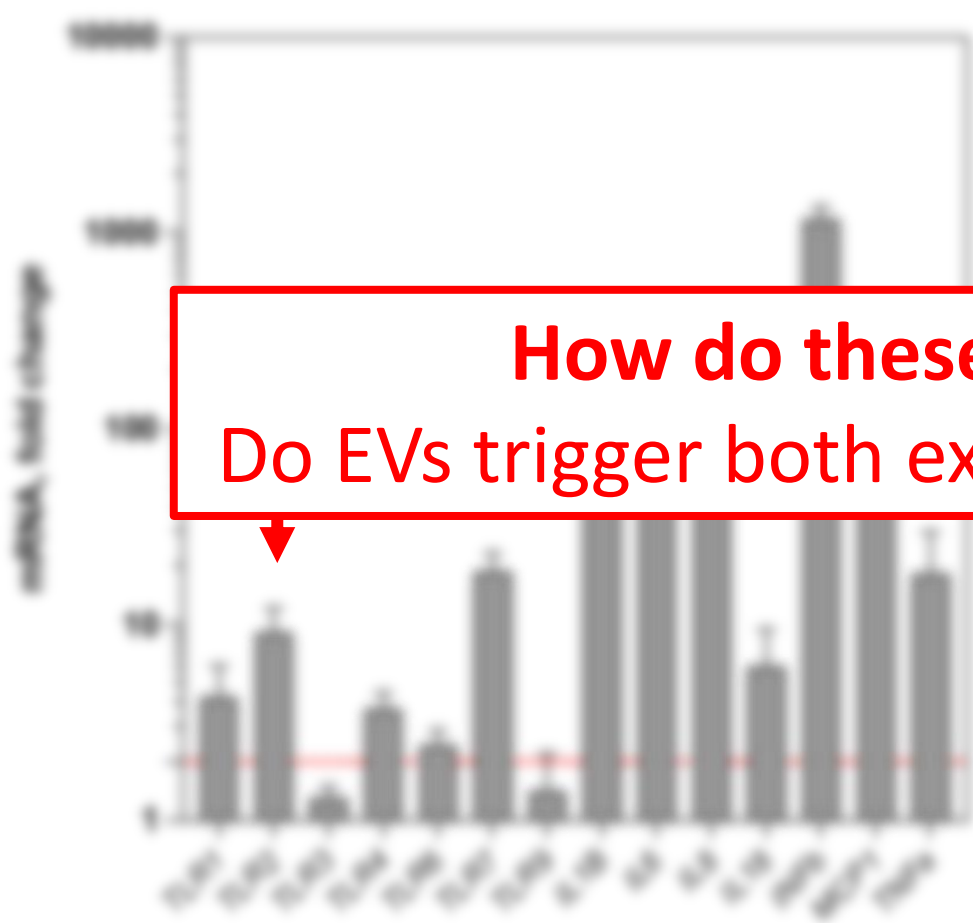


Abbas et al Cell Mol Imm 2015 Elsevier

➔ N315-derived EVs induce the expression of various *TLR* and immune genes in MG-63 cells

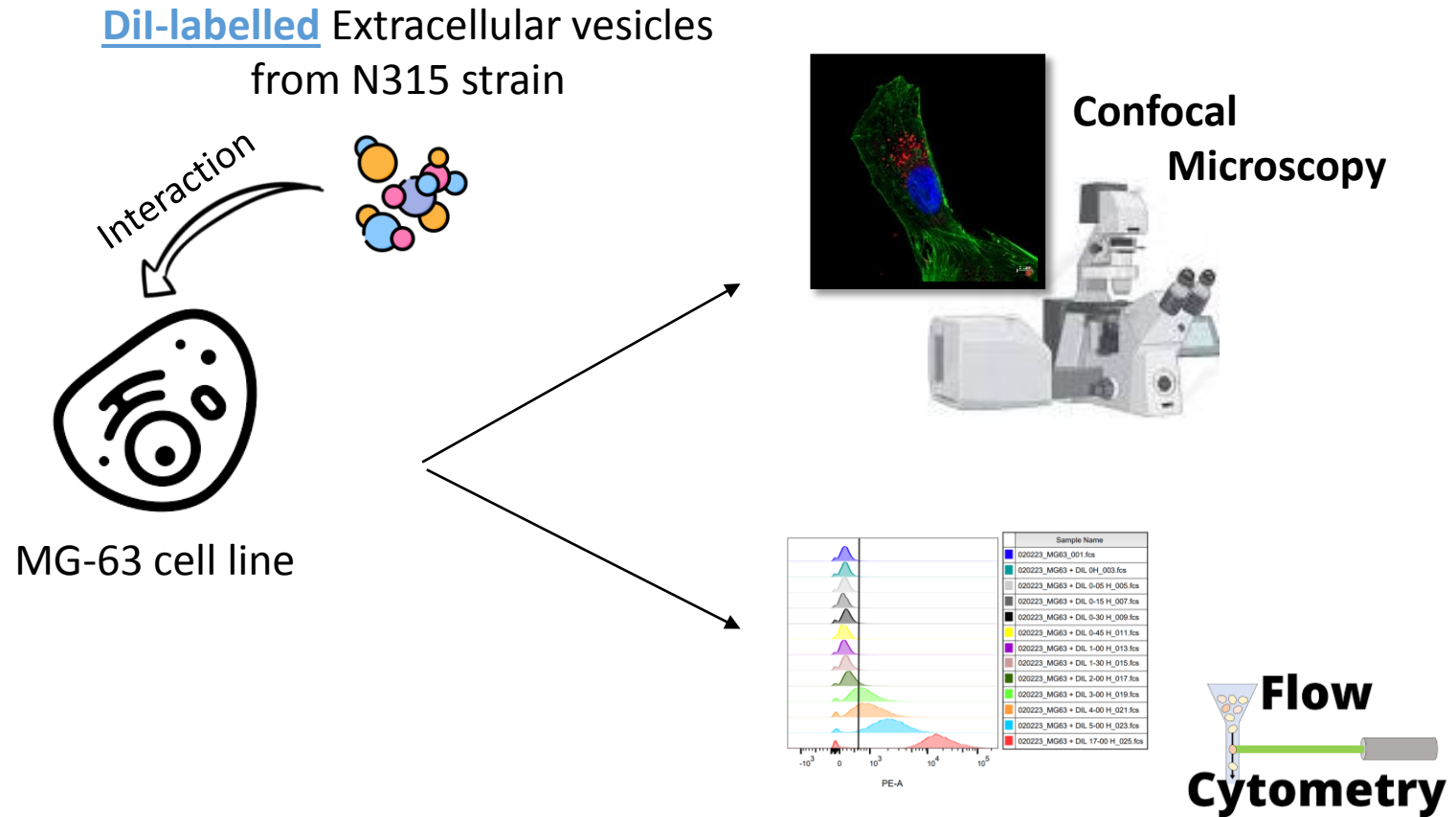
✓ Role of extracellular vesicles in pathogenesis

Impact of EVs on the expression of several inflammatory genes

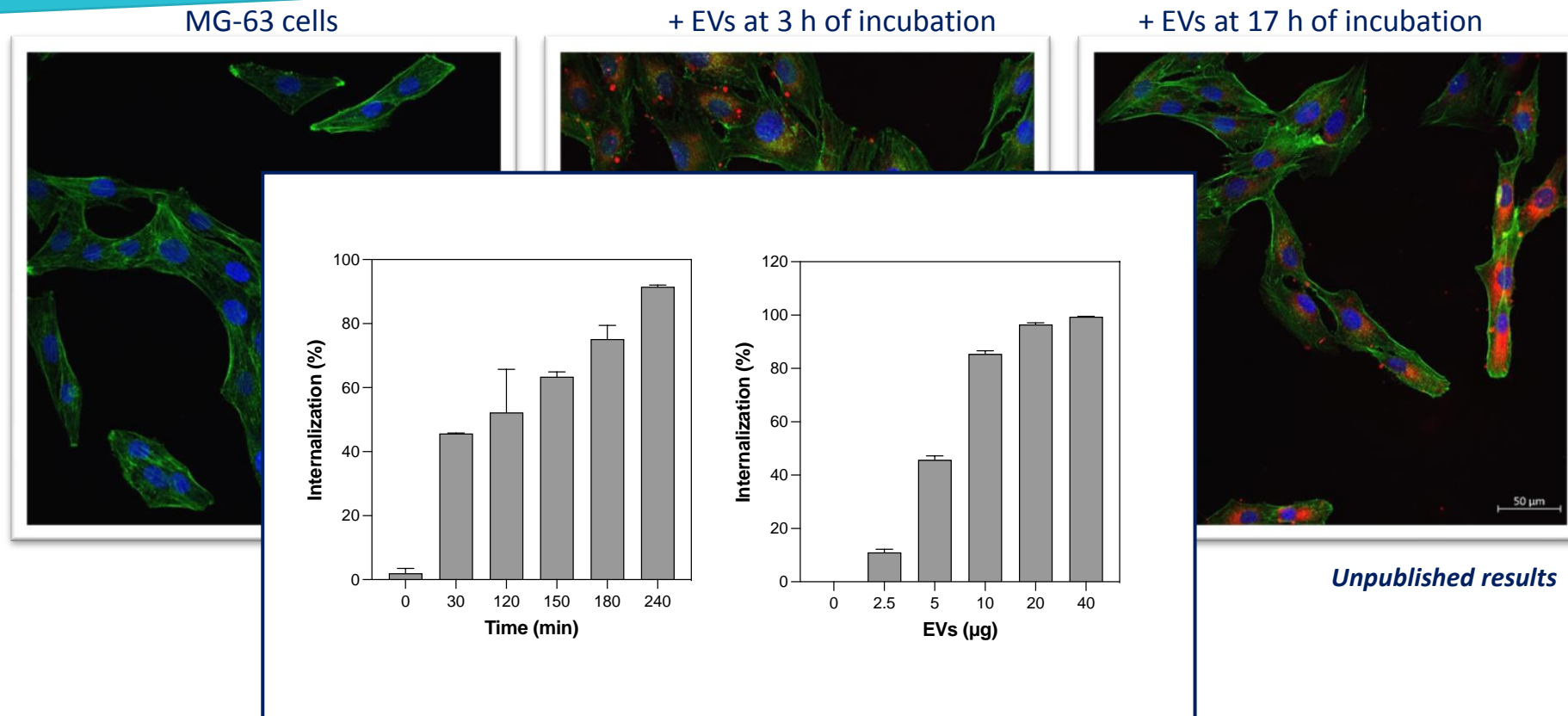


How do these EVs interact with host cells?
Do EVs trigger both extracellular and intracellular pathway ?

→ N315-derived EVs induce the expression of various *TLR* and immune genes in MG-63 cells



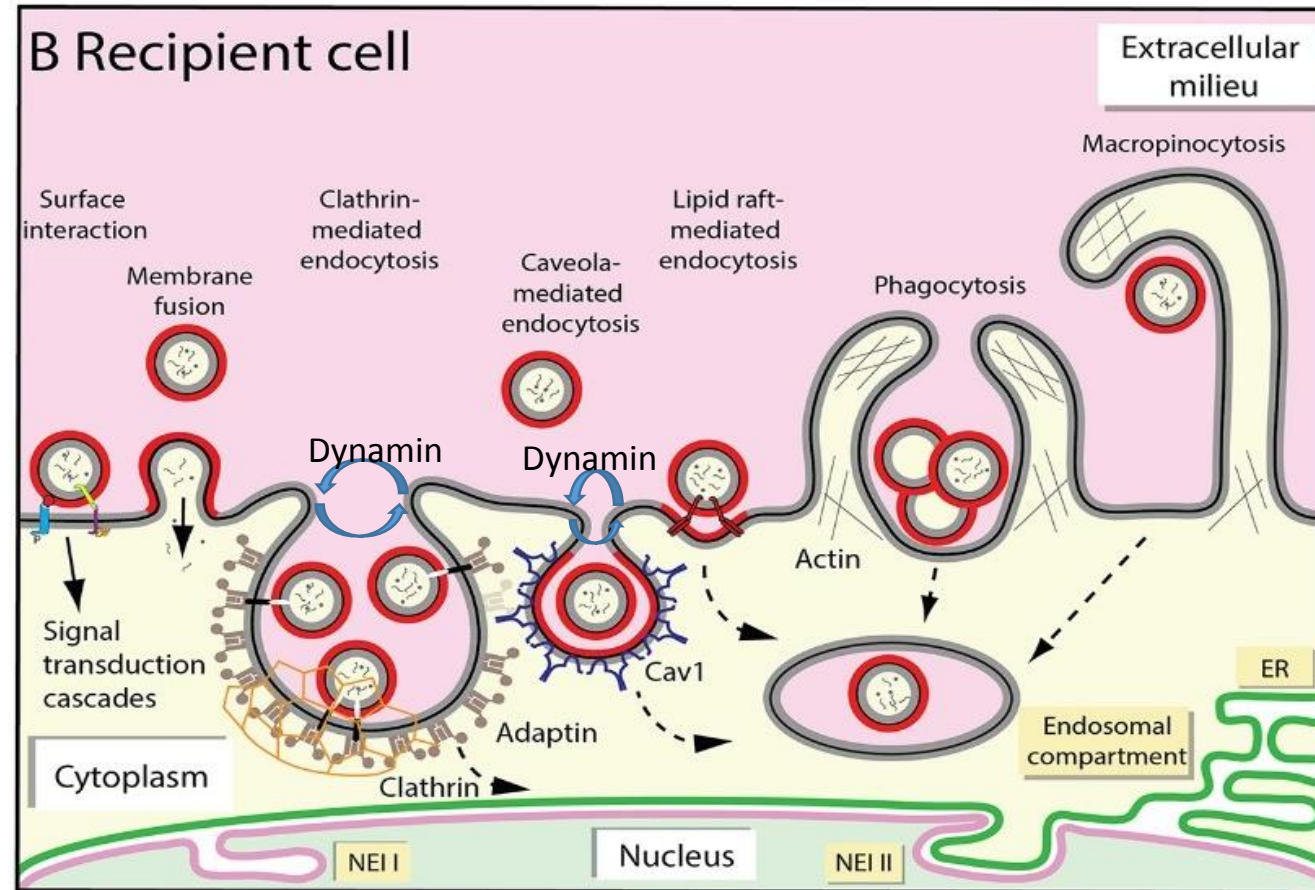
✓ Internalization of EVs by MG-63 cells



→ *S. aureus* N315-derived EVs are internalized by MG-63 cells

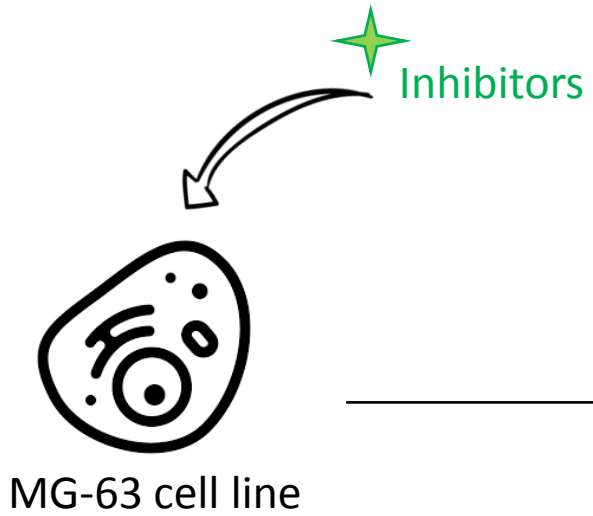
- in a dose-dependent manner
- in a time-dependent manner

✓ Internalization of EVs by MG-63 cells

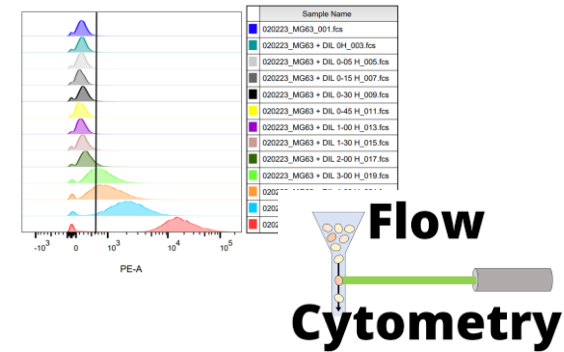
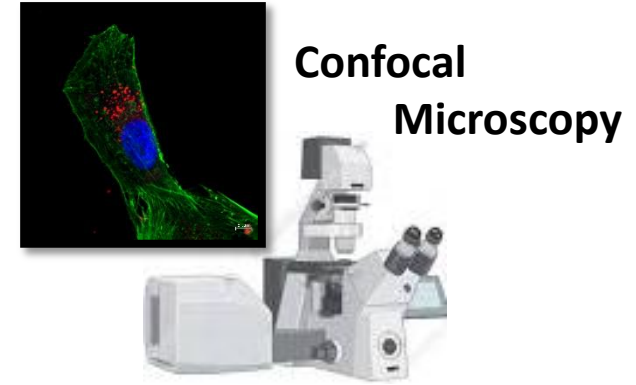
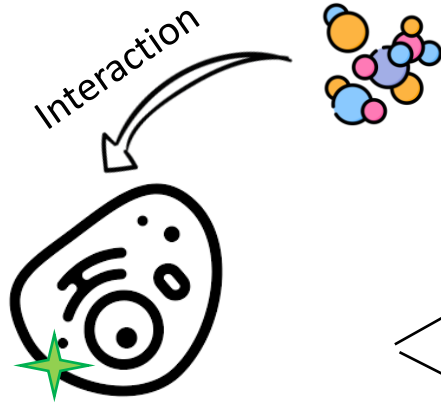


Corbeil et al., 2020

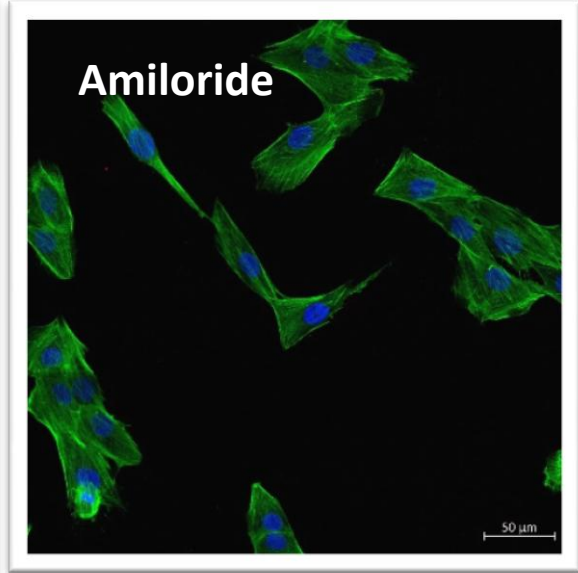
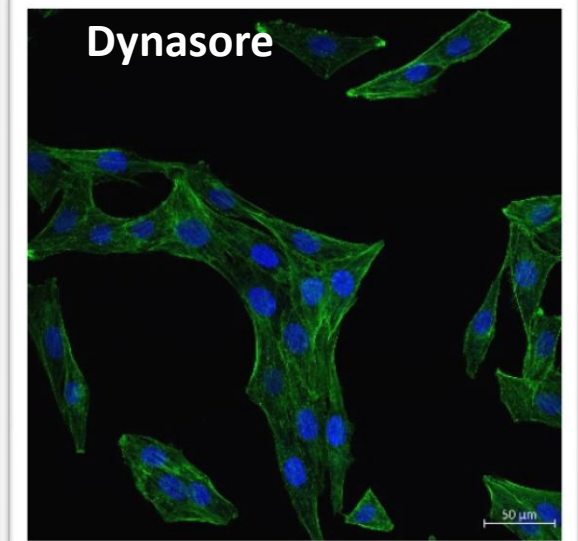
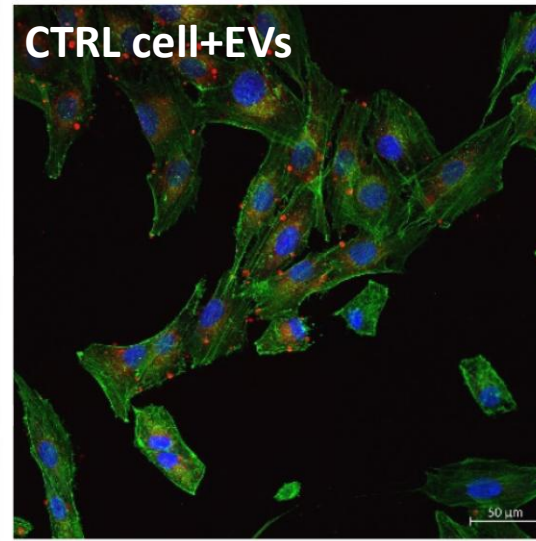
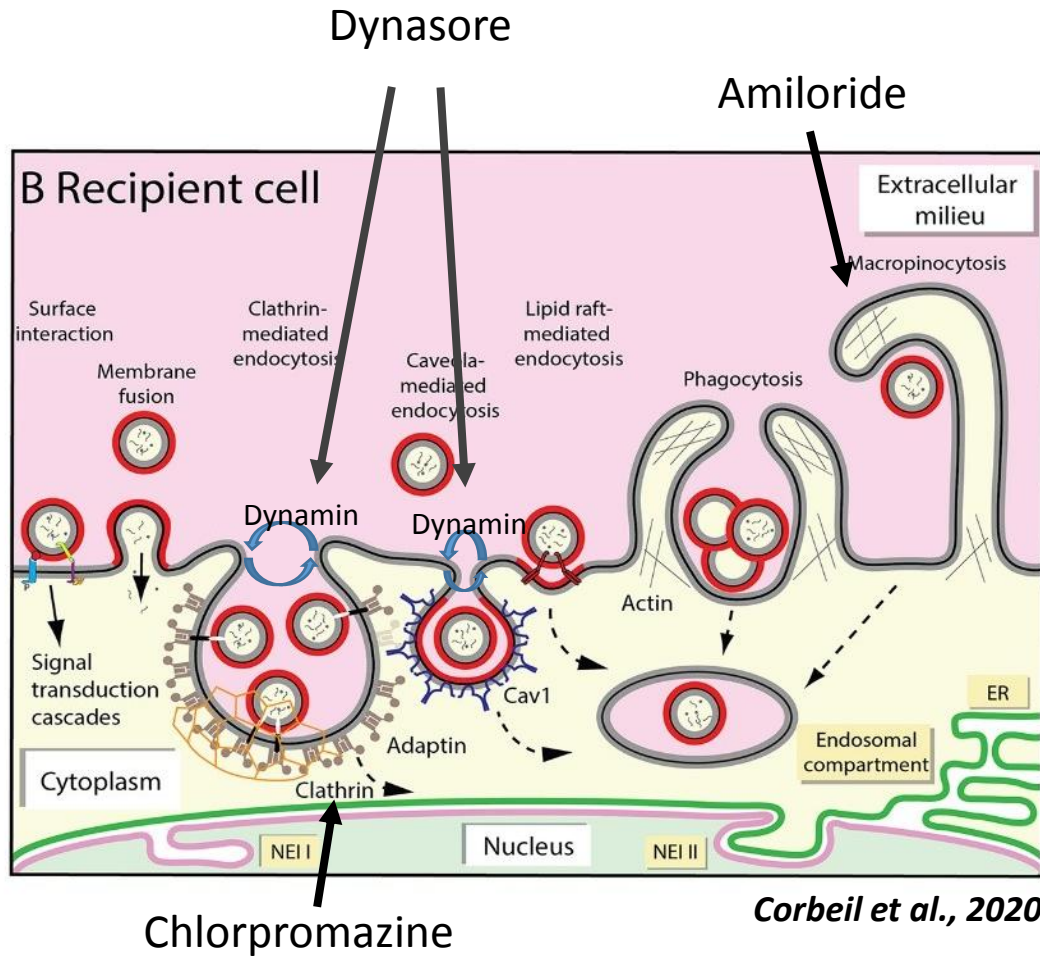
→ Several different pathways of internalization are possible



Dil-labelled Extracellular vesicles
from N315 strain



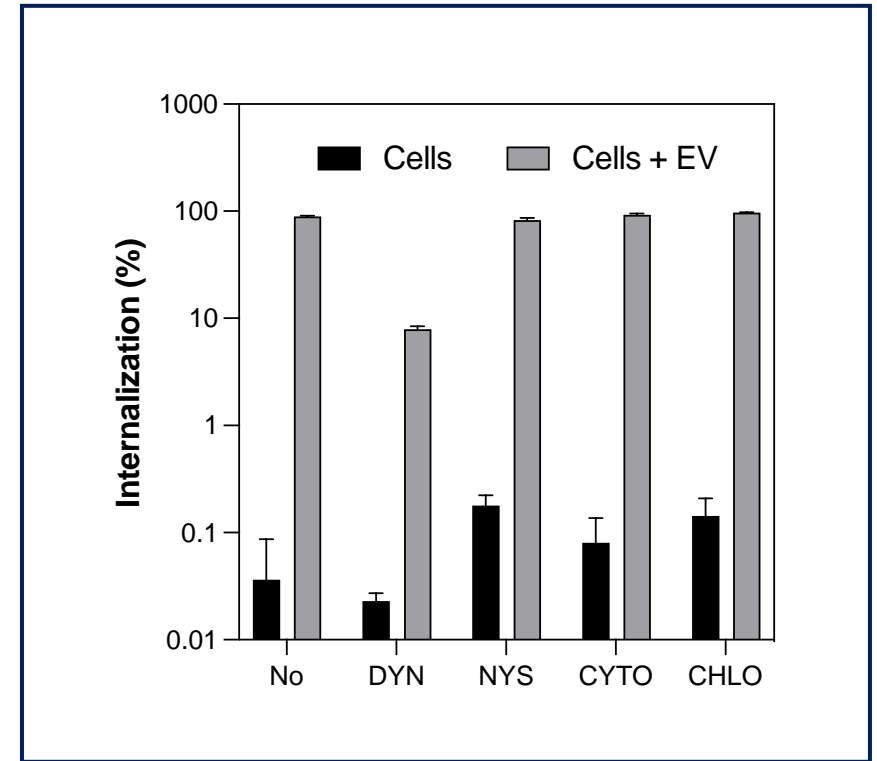
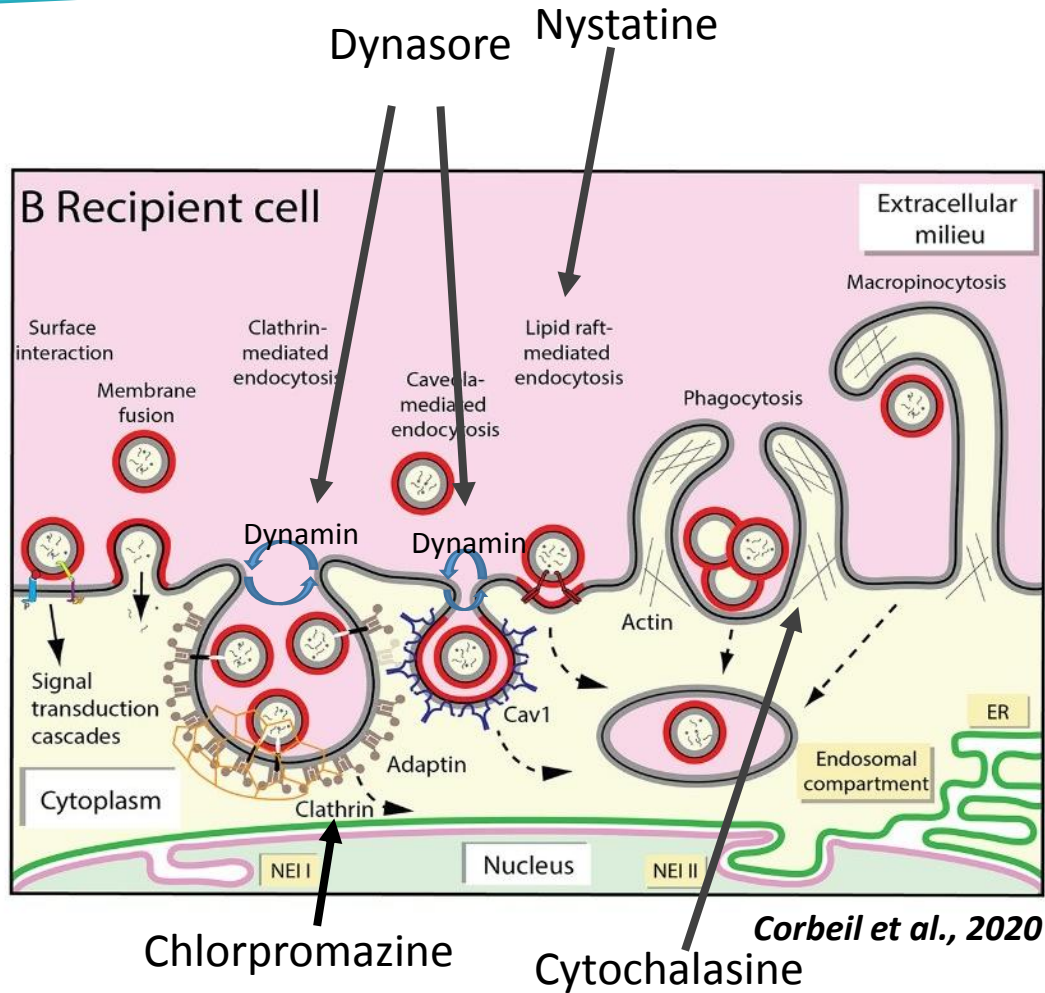
✓ Internalization of EVs by MG-63 cells



Unpublished results

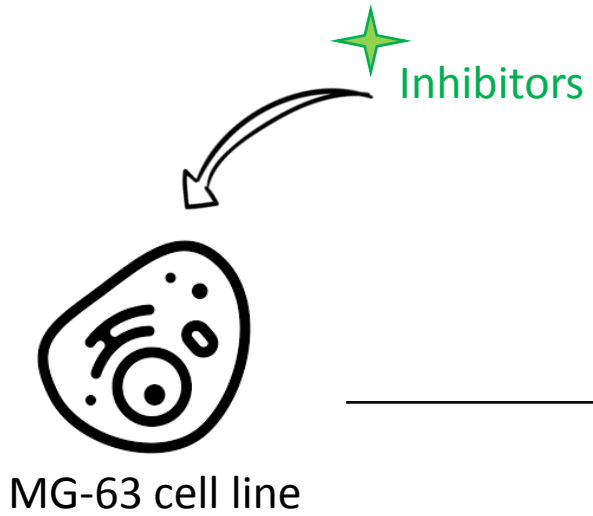
→ Internalization of N315 EVs can depend upon dynamin-mediated endocytosis and macropinocytosis

✓ Internalization of EVs by MG-63 cells

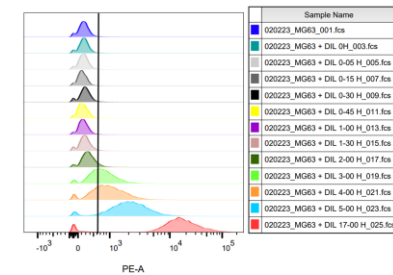
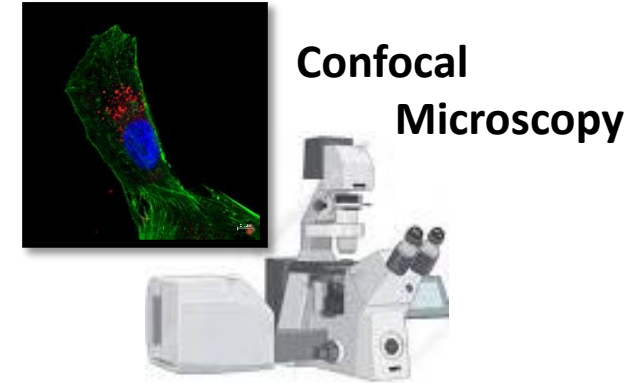
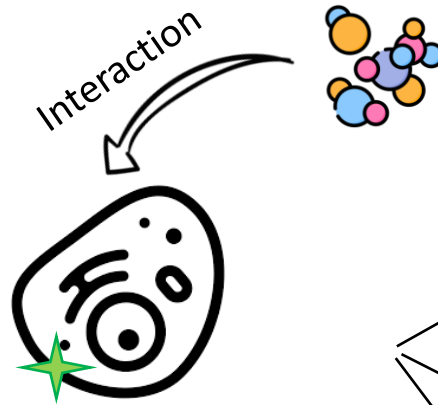


Unpublished results

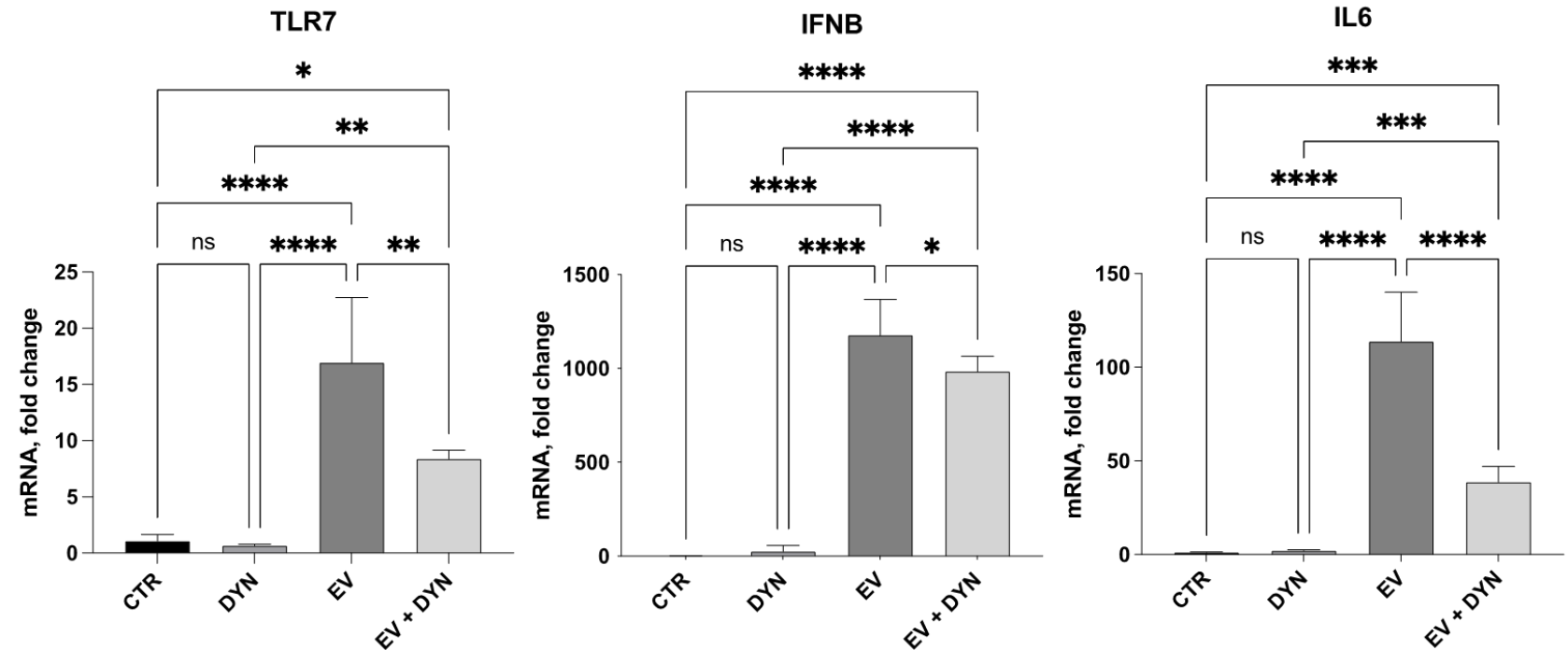
→ Internalization of N315 EVs can depend upon dynamin-mediated endocytosis and macropinocytosis



Dil-labelled Extracellular vesicles
from N315 strain



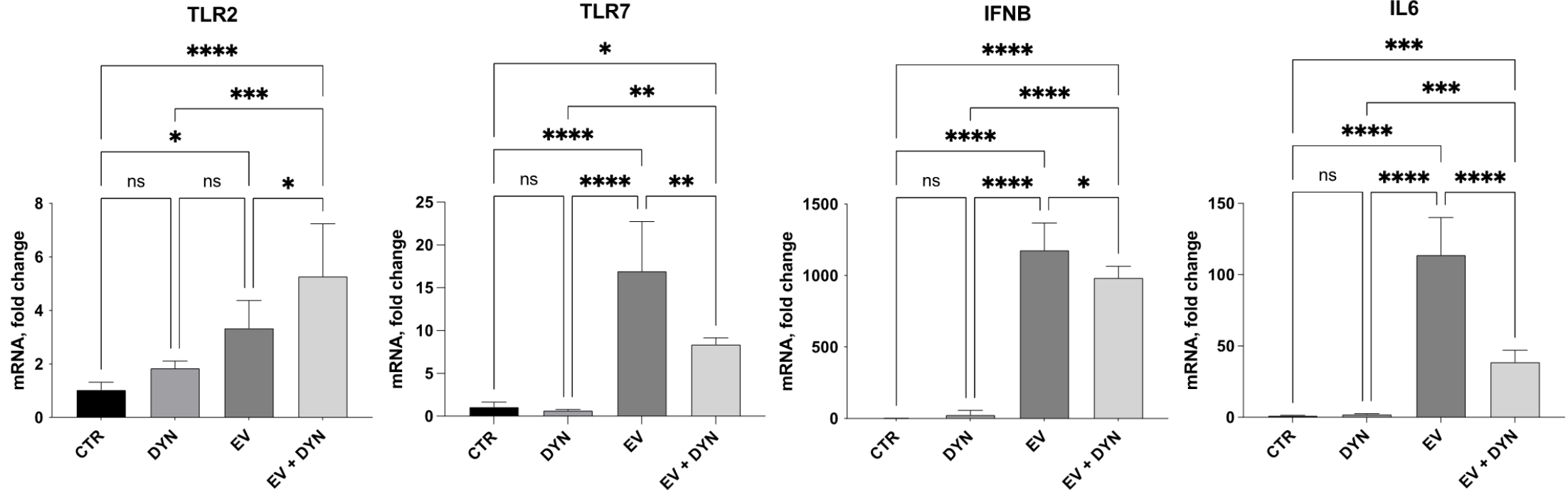
✓ Modulation of genes expression



→ The induced expression mediated by EVs of *TLR7*, *IFNβ* and *IL-6* genes is dependent on the internalization of EVs

→ Several pathways can be used by EVs to interact with host cells

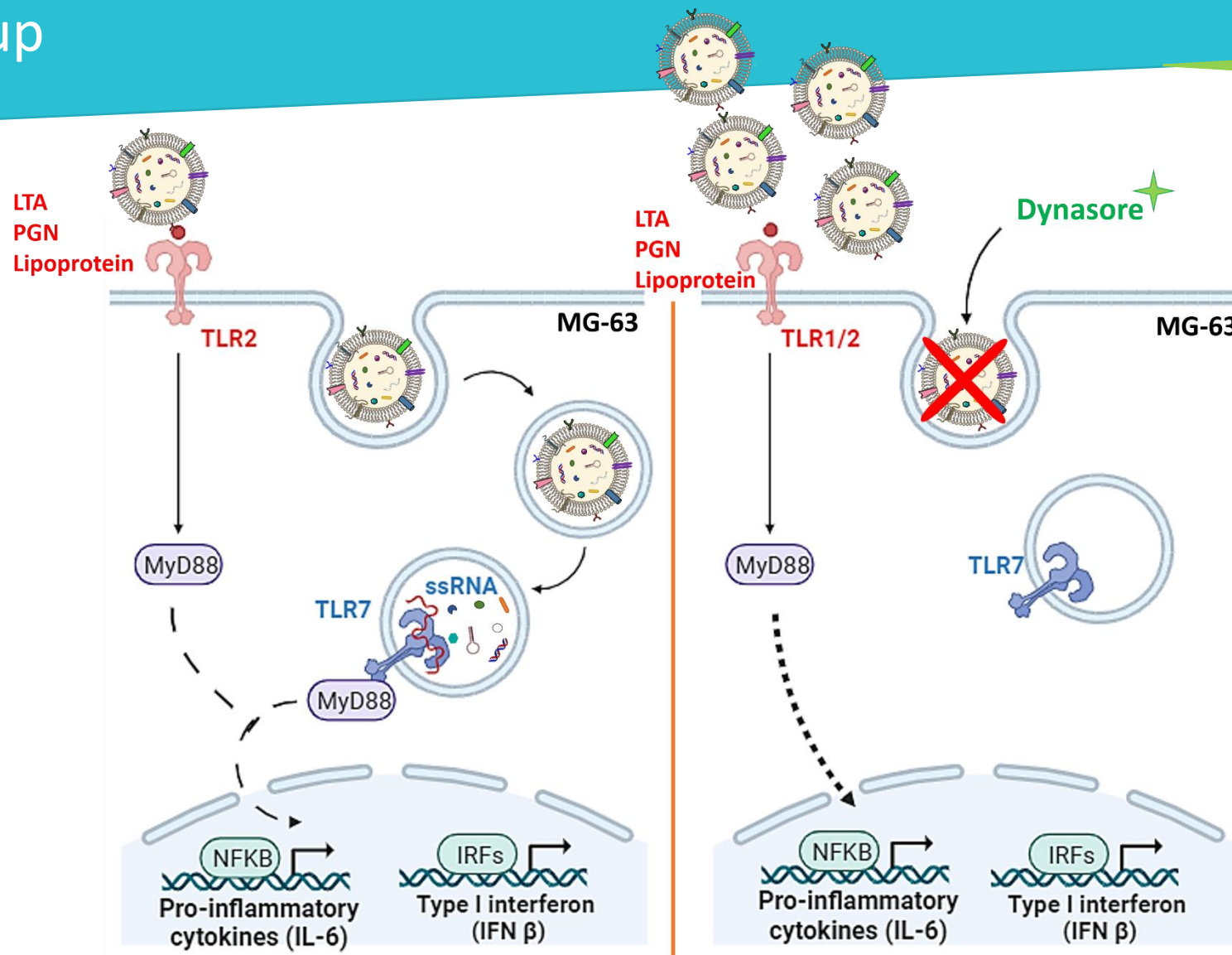
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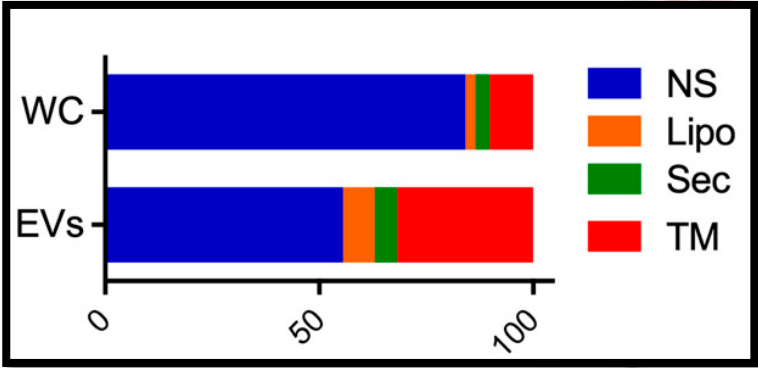
✓ To sum up



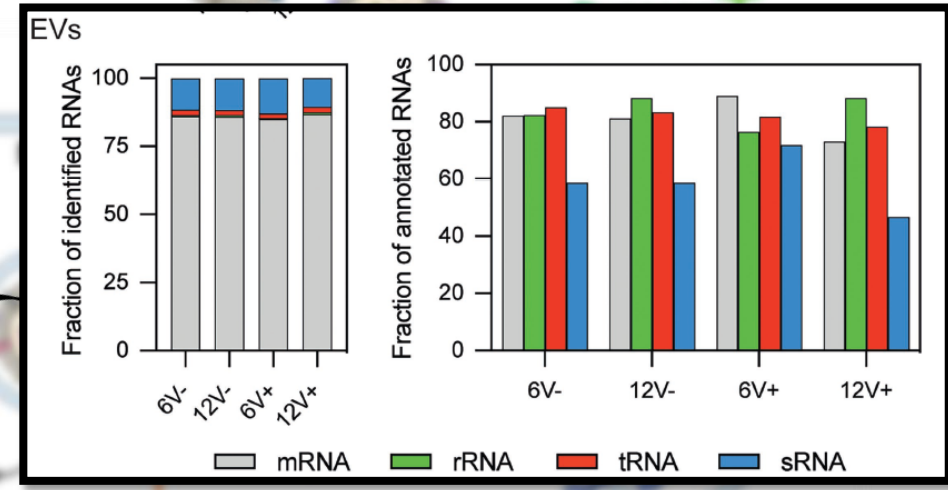
- N315-derived EVs can trigger both extracellular and intracellular signaling pathway in host cells
- Several EV components (proteins, RNA) can be involved in the interaction with host cells

✓ To sum up

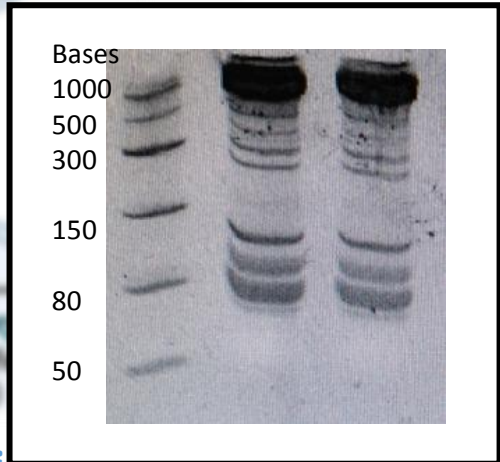
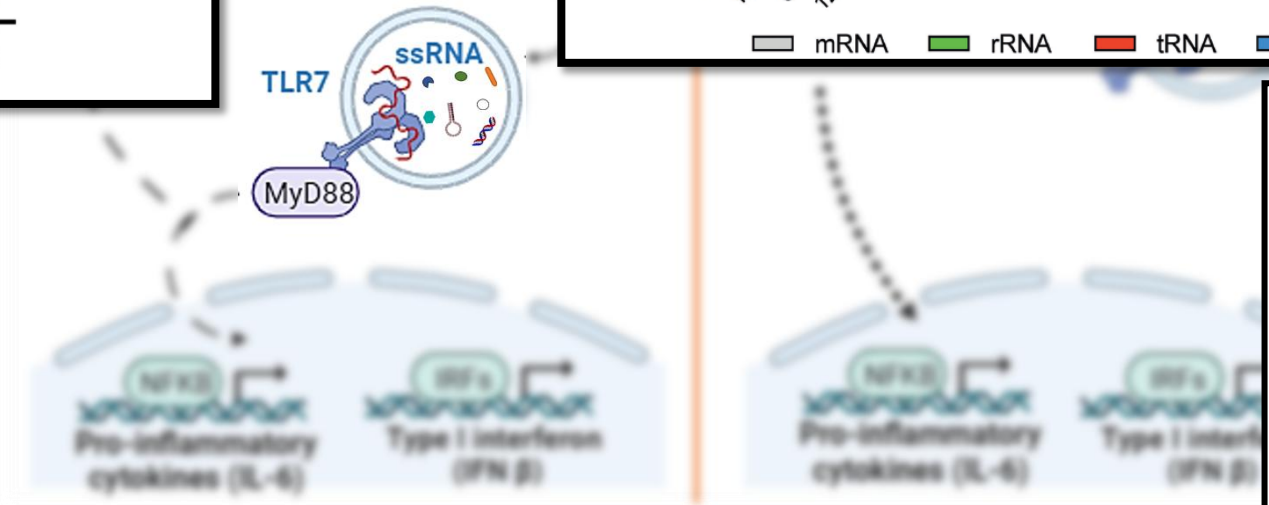
Lipoproteins



Luz and al., 2022

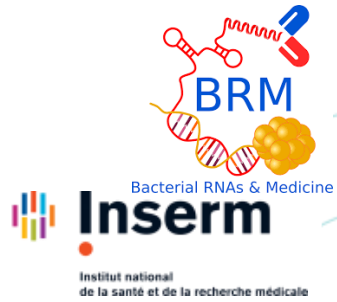


Luz and al., 2021



- N315-derived EVs can trigger both extracellular and intracellular signaling pathway in most cells
- Several EV components (proteins, RNA) can be involved in the interaction with host cells

Thanks



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