# Loading, Release, Biodegradation, and Biocompatibility of a Nanovector Delivery System

**This method enables targeted delivery of therapeutic or imaging agents within a patient by means of nested nanoparticles.**

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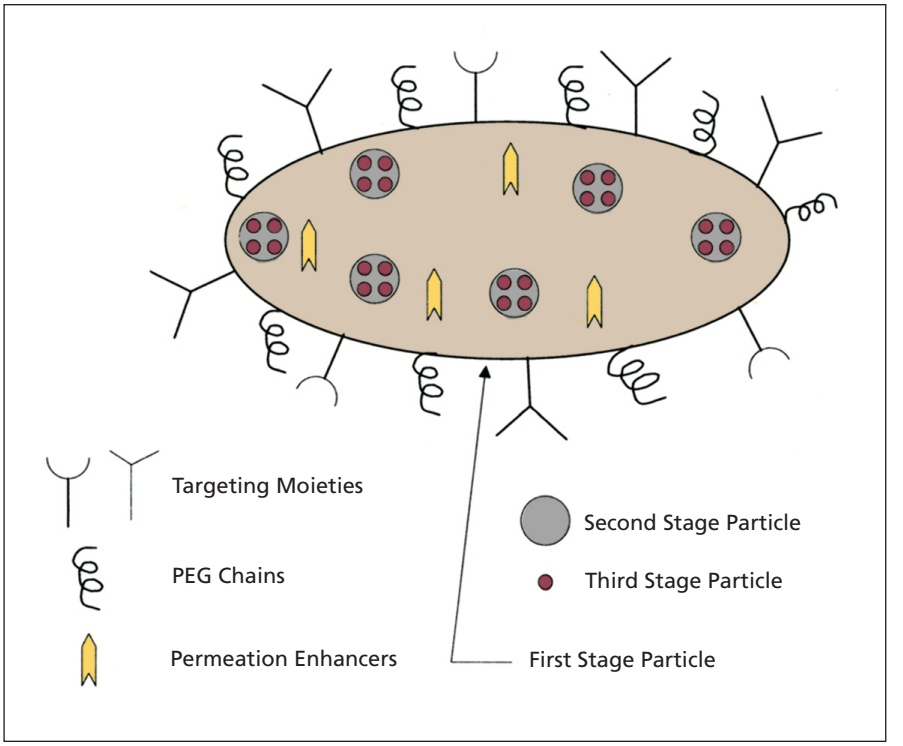
A nanovector multistage system has been created to overcome or bypass sequential barriers within the human body, in order to deliver a therapeutic or imaging agent to a specific location. This innovation consists of a composition that includes two or more stages of particles, such that smaller, later-stage particles are contained in the larger, early-stage particles (see figure).

Such multistage compositions provide several advantages. An active agent, such as a therapeutic agent or imaging agent, is preferentially delivered and/or localized to a particular target site in the body of a subject. The multistage composition overcomes multiple biological barriers in the body. The multistage composition also allows for simultaneous delivery and localization at the same or different target sites of multiple active agents.

Following administration, an active agent formulated conventionally, or in a nanovector, encounters a number of biological barriers that adversely impact the agent's ability to reach an intended target at a desired location. Because these barriers are sequential, the method for overcoming or bypassing them has to be sequential as well. In this innovation, each stage of the vehicle is defined by a particle having a separate intended function, which may be different from an intended function of a particle of another stage. For example, a particle of one stage is designed to target a specific body site, which may be different from a site targeted by a particle of another stage.

A particle of each subsequent stage is contained inside a particle of an immediately preceding stage. A particle of any particular stage may contain an active agent, such as the therapeutic agent or an imaging agent, intended for use at this particular stage. The number and type of stages in the multistage delivery vehicle depends on several parameters, including administration route and an intended final target for the active agent.




In the **Multistage Delivery Vehicle**, the first-stage particle contains second-stage particles and an additional agent such as an imaging or therapeutic agent. The second-stage particles may contain third-stage particles. Targeting moieties such as antibodies attached to the first-stage particle facilitate localization at the selected body site.

Sometimes, the particle of the first stage is a micro or nano particle. Other times, the first-stage particle has a characteristic size of at least 500 μm, or at least 1 mm. Such a particle may be configured to contain inside at least one micro or nano particle, which, in turn, may contain inside at least one particle of a smaller size. The first stage particle is a top-down fabricated particle, i.e., a particle prepared by top-down microfabrication or nanofabrication methods, such as photolithography, electron beam lithography, X-ray lithography, deep UV lithography, or nanoprint lithography. A potential advantage of using the top-down fabrication methods is that such methods provide for a scaled-up production of particles that are uniform in dimensions.

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