# Nanocarriers for targeted drug delivery

## Benefits and challenges of nanotechnology for medicine

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# Nanocarrier delivery systems

**Definition: nanocarrier**

- Biocompatible nanoparticle encapsulating a drug

**Characteristics**

- Nanometre scale
- Low toxicity
- Hydrophilic
- Soluble

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# Targeted drug delivery

## How is targeted drug delivery effective?

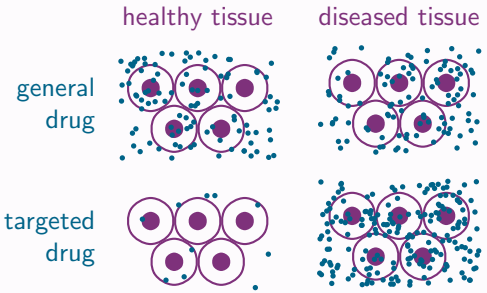


**Figure 1:** *Goal is to increase drug concentration ratio for diseased tissue.*

## Targets diseased tissue

- Maximise therapeutic effects
- Minimise effective drug dose

## Avoids healthy tissue

- Minimise side-effects

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# Vascular permeability

**Definition: vascular permeability**

- Tendency for molecules to leak from blood vessels into interstitial space between cells.

**Contributing factors**

- Permeability enhancers such as *bradykinin* and *nitric oxide*
- Dense and defective vascular network
- Enhanced vascular permeability has been observed in solid tumours and inflamed tissue [1]

[1] H. Maeda *et al.*, *Journal of controlled release* **65**, 271–284 (2000).

# Enhanced Permeability and Retention effect

**Definition: EPR effect**

- Tendency for large molecules, such as nanocarriers, to accumulate in solid tumours and inflamed tissue

**Accumulation procedure**

1. Molecules leak into interstitial space due to enhanced vascular permeability
2. Smaller molecules diffuse back into blood vessels and lymph nodes
3. Larger molecules become trapped

# Stimuli-responsive nanocarriers

## Biological stimuli

- Tumours have been observed with lower pH than healthy tissue [2]
- Organelles maintain their own unique pH and redox status
- Difference in intracellular and extracellular redox status [3]

## External stimuli

- Electromagnetic fields
- Heat
- Ultrasound
- Light

[2] L. E. Gerweck, K. Seetharaman, *Cancer research* **56**, 1194–1198 (1996).

[3] G. Saito *et al.*, *Advanced drug delivery reviews* **55**, 199–215 (2003).

Thank you, any questions?

## References


1. H. Maeda *et al.*, *Journal of controlled release* **65**, 271–284 (2000).
2. L. E. Gerweck, K. Seetharaman, *Cancer research* **56**, 1194–1198 (1996).
3. G. Saito *et al.*, *Advanced drug delivery reviews* **55**, 199–215 (2003).


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