

## Supplementary Evidence from the Biotechnology and Biological Sciences Research Council (BBSRC)

### Foetal risk from nanoparticles.

This is a frequently-asked question in the community, with very limited data. There is some unpublished data in rats showing that nanoparticles can cross from the mother to the foetus, and some data from smoke particle studies that also suggests that transfer is possible. There are probably a variety of routes of access, as with gut absorption, and different particles may behave in different ways.

The route to the foetus will probably be through the placenta. The placental membrane is designed to separate the foetus and mother's blood circulation whilst facilitating nutrient transport. The membrane is not a simple size-selector; many of the mechanisms by which nutrients and other molecules are transferred involve activity within the membrane. A recent review is Jones et al (2007). The involvement of the placenta in toxicology is discussed in detail by Myllynen et al (2005). Blackburn (2007) reviews transport of molecules to the foetus:

- *Small molecules* (less than molecular weight 100 if water-soluble, ie. sub-nm in size) can cross the membrane by simple diffusion; this is the mechanism by which alcohol can enter the foetus;
- *Larger molecules* and structures enter through other mechanisms; for example, some very large molecules (such as immunoglobulin G, molecular weight 150,000, which confers immunity) enter by endo- and exo-cytosis; the molecule travels through the placental membrane in a vesicle.
- Some *viruses* can infect the foetus, but it is clear that the placenta provides a barrier; for example maternal–infant transmission rate of HIV is only 25% in mothers who do not receive prophylaxis (Koi et al, 2006). Viruses obviously vary in size (10-300 nm)

It thus seems very unlikely that nanoparticles can enter the foetus through simple diffusion unless they are very small and simple molecules. The mechanism of transport will be different to that of alcohol. Much larger molecules, such as nanoparticles can enter via other mechanism, but will have to stimulate the membrane in the same way as immunoglobulin does. It seems unlikely that transport to the foetus can be completely prevented, but the concentration of any nanoparticle will be substantially less than in the mother.

#### References

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