

# Nanoparticles, Adaptation and Network Medicine: An Integrative Theoretical Framework for Homeopathy

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The manufacturing process of homeopathic remedies involves trituration (mechanical grinding) and/or succussion (vigorous pounding of solutions in glass containers against a hard surface). These processes can generate nanoparticles of specific remedy source substances (e.g. metals or plant materials) as well as non-specific nanoparticles of lactose and silica. This paper summarizes the implications of the recent advances in research into the use of nanoparticles in medicine in general, as well as the discovery of nanoparticles in homeopathic remedies for research and clinical applications.

## Introduction

A central challenge for homeopathic researchers is to identify and test a plausible model for what homeopathic remedies are and how they work.<sup>1</sup> Advances in this area are needed both to address political pressure from skeptics and to improve the quality and consistency of clinical outcomes for patients treated with homeopathy. Recent research findings from multiple disciplines now converge to provide a much-needed integrative theoretical framework for homeopathy. The breakthrough discovery is that homeopathic metal<sup>2</sup> and plant<sup>3-6</sup> remedies contain crude types of nanoparticles, that is, small forms of their source material.<sup>2-6</sup>

The remedy nanoparticles are objectively demonstrable using sensitive types of electron microscopy<sup>2,3</sup> to characterize their structure and properties.<sup>6,7</sup> Additional nano-structures in remedies would arise from trituration of lactose and/or serial dilutions and succussions in ethanol-water solutions within glass containers, generating silica nanoparticles and crystals.<sup>3,6,8</sup>

## What are nanoparticles?

Nanoparticles measure between 1 and 100 nanometers in diameter (for comparison a typical virus measures 10-150 nm in diameter). Their small size leads to a large surface area to volume ratio, giving nanoparticles different properties from those of bulk forms of the same material.<sup>9</sup> For example, otherwise unreactive gold becomes magnetic and a good catalyst for chemical reactions in its nano-form. Both the size and shape (morphology) of nanoparticles determines their altered properties, including unique chemical, biological, optical, thermal, electrical, magnetic and quantum effects.<sup>9</sup>

One way nanotechnologists manufacture nanoparticles, is by intensively grinding solid bulk forms of materials such as water-insoluble drugs or metals with special mechanical milling procedures and/or turbulent mixing in liquid solutions.<sup>10</sup> These "top-down" methodologies bear a striking resemblance to the manufacturing techniques in homeopathy. In the "bottom-up"

approach, nanoparticles are assembled through aggregation of the primary molecules (supramolecular chemistry).

Nanosilica has the property that it is able to attach other materials (e.g. remedy nanoparticles) onto their surfaces. In this way, homeopathic remedies would retain properties of the remedy source material they are made from (e.g. plants, minerals or animals).<sup>4</sup> Manufacturing homeopathic medicines in different potencies (strengths) involves different amounts of trituration and/or succussion, which in turn, would generate different sizes and shapes of nanoparticles.<sup>3</sup>

Multiple laboratories have found measurable amounts of silica and silicon, emanating from the glass container, in classically manufactured homeopathic remedies at low and high potencies.<sup>3,8</sup> Consequently, transfer of remedy-specific structural information to silica nanostructures across potencies is a testable hypothesis to account for information transfer. Nanoparticles derived from the original remedy source material would also provide the nanoseeding templates for the silica nanoparticles during manufacturing. Overall, remedies would include (i) remedy source nanoparticles; (ii) remedy source nanoparticles adsorbed onto lactose and/or silica; (iii) silica nanostructures built upon remedy source nanoparticle templates.

## How Do Nanoparticles Interact with Living Systems?

Conventional medical researchers focus on using nanoparticles to improve drug, vaccine, and nutraceutical delivery.<sup>11</sup> Nanoforms of drugs or vaccines can markedly reduce - by orders of magnitude - the total dose of an agent needed to produce a significant biological effect, due to (a) the ability of nanosized particles to go directly through cell membranes, including the blood-brain barrier, to reach their targets, even inside cells; and (b) the increased catalytic nature of nanoparticles in general. Using lower doses of a drug leads to reduced side effects with some nanomedicines, another finding which parallels the excellent safety record of homeopathic remedies.

Homeopathic plant and metal remedies have been shown to have specific modulating effects on gene activation patterns and biological signaling pathways involved in cellular defenses.<sup>6,12</sup> It appears that both nanoparticles and homeopathic remedies may modulate epigenetic, genetic and metabolic functions, including mobilizing inflammation, cytokines, reactive oxygen species (free radicals) and heat shock proteins. Nanosilica has been shown to activate the biological stress response and immune defense pathways of the body<sup>13</sup>. Thus, remedy-modified nanosilica could act not only as a vehicle for source-specific structural information at higher potencies, but also as a biological amplifier for remedy-specific responses at any potency.

### Living Systems as Complex Adaptive Networks

Nanoparticles have been shown to cause hormesis<sup>14</sup> i.e. lower doses trigger a beneficial adaptive response, while higher doses have an opposite effect. During hormesis, the substance does not exhibit a direct conventional drug effect. Rather, it stimulates the organism's internal processes of biological adaptation (designed to defend against future exposures to the same or similar substance) which in turn produces beneficial changes and ultimately initiates healing.

The organism strives to recover steady state and maintain its survival and functionality in the face of the threat from the remedy nanoparticles perceived as an external "threat" or stressor.<sup>1</sup> Thus, adaptive changes that occur across the organism in the course of hormetic responses to the remedy, as a low level biological stressor, would underlie the resultant healing events.

### Conclusion

The recent explosion of research on nanoparticles and nanomedicine enables homeopathic researchers to develop and perform theory-driven biologically-based research programs in their own field. The data suggest that the crude manual manufacturing methods for homeopathic remedies, interacting with the complex adaptive system nature of living organisms, could underlie both the positive clinical case reports and the variability of findings in homeopathic research. The scientific possibilities that arise from testing a nanoparticle-based adaptation model for homeopathic remedy effects merit exploration.

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