



# Systems biology approach opens door to essence of acupuncture

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**Summary** For World Health Organization proposed 'Health for All', we should be to promote the use of traditional medicine. Traditional Chinese acupuncture has a history over 3000 years and is effective in the treatment of many conditions with few side effects. Acupuncture, an intrinsic part of traditional Chinese medicine (TCM), which utilizes fine needles to pierce through specific anatomical points (called "acupoints"), has been extensively used and has emerged as an important modality of complementary and alternative therapy to Western medicine. It is vital and necessary to explore the underlying biological mechanisms of acupuncture. Systems biology has become practically available and resembles acupuncture in many aspects and is current key technology that serves as the major driving force for translation of acupuncture medicine revolution into practice, will advance acupuncture therapy into healthcare for individuals. High-throughput genomics, proteomics and metabolomics in the context of systems biology have been able to identify potential candidates for the effects of acupuncture and provide valuable information toward understanding mechanisms of the therapy. To realize the full potential of TCM acupuncture, we describe the current status of principles and practice of acupuncture integrated with systems biology platform in the post-genomic era. Some characteristic examples are presented to highlight the application of this platform in omics and systems biology approaches to acupuncture research and some of the necessary milestones for moving acupuncture into mainstream health care.

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## Introduction

Traditional Chinese medicine (TCM) has its own unique system of knowledge, which fundamentally defines all of its therapeutic procedures.<sup>1</sup> Acupuncture (belonging to 14 meridians) is a core component in TCM and can be traced back more than 3000 years in China.<sup>2</sup> It has been widely used to reduce some symptoms or to treat diseases in clinical practice.<sup>3</sup> More recently, the practice of acupuncture has become prevalent in the United States and Europe, with over 9 million people recent use of acupuncture.<sup>4</sup> The health care paradigm has shifted from a focus on diseases to a holistic approach to health care.<sup>5</sup> Evidence-based medicine is switching from the analysis of single diseases at a time toward an integrated assessment of a diseased person. Fortunately, acupuncture has been extensively used and has emerged as an important modality of complementary therapy to modern medicine, affords new significance of health care and advances the practice research.<sup>6</sup>

Acupuncture has developed its own coherent theories with regard to diagnosis and treatment of disease and accrued a myriad of valuable clinical observations, some of which have provided the basis for successful personalized medicines.<sup>7</sup> Acupuncture uses a unique holistic approach to cure human diseases through establishment of equilibrium in the human life, body, mind, intellect and soul, so satisfactory treatment results could be achieved.<sup>8</sup> The area of integrating acupuncture with systems biology approach has



**Figure 1** Acupuncture.

become a major hot of TCM research. Recent advances in systems biology technology have enabled the discovery of biomarkers, provided the basis for the development of new targeted drugs, potentially offered 'the right therapy for the right patient'.<sup>9</sup> Such technologies, *e.g.* genomics, proteomics, metabolomics, have be able to identify biomarkers of a particular disease within the set of genes, proteins and metabolites of a given organism.<sup>10</sup>

During the past 30 years, a large number of studies focused on the mechanism of acupuncture, which made it more acceptable to clinical practice and mechanism research.<sup>11</sup> Combining the systems biology with in-depth investigations of acupuncture mechanisms will enable a revolution in our understanding of disease pathology and will advance personalized medicine.<sup>12</sup> There are new signs that the pursuit of both acupuncture and systems biology will be a priority for people and advances paving the way toward health care.<sup>13–15</sup> In order to realize the potential role of acupuncture, the current understanding of the acupuncture system, acupoints and the potential utilizing systems biology technologies are summarized in this review (Figs. 1 and 2).

## Basic principles of acupuncture

Acupuncture has been used for thousands of years to treat diseases and has many beneficial effects for disease control. A key term that relates to needling sensation is Deqi or 'vital energy', and this state is essential to acupuncture's therapeutic effect.<sup>13</sup> Based on the theory of TCM, acupuncture is successful only with the experience of Deqi, which suggests correct localization of the acupuncture point, and the arrival of Qi. Deqi should be taken into account in clinical trials and, further research is required to understand the underlying mechanisms.<sup>14</sup> Acupuncture theory is based on the premise that Qi goes along determined pathways or meridians within the body and is responsible for maintaining good health by providing homeostatic regulation of vital body function.<sup>15</sup> In TCM, diseases are believed to result from imbalances and disturbances in the flow of "Qi" within the body, thus acupuncture consists of treatments by insertion and manipulation of needles at specific anatomic locations (acupoints) in the body with the intent of regulating the energy flow and restoring that balance. In acupuncture, the placement of needles into the body is dictated by the location of meridians, thought to mark patterns of energy flow throughout the human body in TCM.<sup>16</sup>

Classic theory recognizes about 361 points. All were said to be located on 14 main meridians connecting the body in a web-like interconnecting matrix. Traditionally, each acupuncture point has defined therapeutic actions. In acupuncture practice, during subsequent treatment sessions repeated pulse-taking and feedback about the effects of needle insertion are often varied to take into account

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