

**BIOINFORMATICS POLICY of CHINA (2000 to 2014) – A REPORT**

WORKING PAPER No. 44

Rising Powers Research  
funded by the  
Economic and Social Research Council (UK ESRC)

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1 December 2014



## Government policies towards bioinformatics in China

The emergence of bioinformatics in China can be traced to the end of the 1980s when a small group of Chinese scientists from other disciplines, noticeably physics and mathematics, started studying biological questions by drawing upon computational skills and tools (Wei and Yu, 2008). Since the Internet boom, the Chinese government acknowledged the crucial role of information technology in biological studies and life sciences. Before the term bioinformation technology first appeared in the <10<sup>th</sup> five-year plan for science and technology development> as a cutting-edge technology, the Ministry of Science and Technology (MOST) and Natural Science Foundation of China (NSFC) attempted to support bioinformation technology, or bioinformatics research, from the late 1990s in applied research and basic research perceptively.

The National High-tech Development Programme (863 Programme) managed by MOST put the development of bioinformatics on the agenda by the end of the 9th five-year (1995-2000) plan and funded several projects for building infrastructures for bioinformatics. This includes funding an exploratory project 'Development and Establishment of Database for Bioinformatics' and supporting establishment of the first centre for bioinformatics in China (CBI) within the College of Life sciences at Beijing University, in 1996, which is the official mirror site of major international biological databases (Wei and Yu, 2008). Meantime, the NSFC also supported three exploratory research projects on bioinformatics ([isisn.nsf.gov.cn](http://isisn.nsf.gov.cn)).

Despite the appearance of bioinformatics in the <10<sup>th</sup> five-year plan for science and technology development>, most biological scientists were still unfamiliar with bioinformatics database and Internet-based web services and analytical tools. Therefore, the main task of policy is to spread bioinformatics knowledge and build infrastructure for bioinformatics, enabling comprehensive research and profession network and community cultivation. In light of the <10<sup>th</sup> five-year plan for Natural Science Foundation of China>, the foundation officially listed bioinformation technology as a funding topic under the scheme of bio-chemistry, bio-physics and biomedical engineering in 2002; 863 programmes formally announced that bioinformation technology is one of the four key funding areas in the category of biology and modern agriculture in 2003 and thereafter funded two large scale research projects i.e. 'establishment of national base for bioinformatics' and 'key theory and application of bioinformatics' (Zhao, 2003). Another funding agency managed by MOST – National Key Basic Research Development programme (973 programme) also favoured bioinformatics by supporting two main specific application areas, i.e. research on genome of crop and farm animal, and research on human genome and proteome. With the support from funding agencies, over 20 databases of local species were created by Chinese scientists, including databases for genome of plants, silkworm, chicken, rice, protein and etc (Wei and Yu, 2008).

In order to support national science development and technology R&D, the MOST planned to centralise geographic distributed sources by launching the National Science and Technology Infrastructure Programme in 2004. One of the elements of this programme is to establish Bio-Grid by collaborating with the Ministry of Education (MOE). Drawing

upon existing network and grid computing resources in eight top Chinese universities, Bio-Grid integrated foreign databases of bioinformation and bioinformatics software tools for supporting future biology and life sciences research. Except for central government, local governments in developed areas were also committed to supporting bioinformatics development. For example, Shanghai city invested 11.4 million RMB (approximately 1.14 million GBP) for the establishment of Shanghai Centre for Bioinformation Technology ([www.scbit.org](http://www.scbit.org)) by integrating intelligent resources from several local universities and Shanghai Institute for Biological Science of CAS, in 2002. The SCBIT not only serves as the central repository for biological data generated throughout Shanghai and neighboring areas, but also provides bioinformatics resources and web services for public and private sectors. After three years, Shanghai Society of Bioinformatics was founded based in SCBIT, which is still the only scientific community for bioinformatics in China.

Inspired by the result of Human Genome Project, Chinese policy-makers acknowledged that bioinformatics itself is a promising subject which enables deep understanding of human life and boost of the development of biomedical research and biomedical industry. The state council issued the <National Medium- and Long-Term Programme for Science and Technology Development (2006-2020)> as a guideline, based on which all S&T policies are to be made for the next 15 years. This long term programme conveys that the Chinese government continues supporting bioinformatics development, but also pays much more attention to application areas using bioinformatics as a research method. Therefore, bioinformatics appeared in not only the <11<sup>th</sup> five-year plan for science and technology development> under the scheme of ‘Biological and Medical Technology’, but also in the <11<sup>th</sup> five-year plan for natural science foundation of China> and <11<sup>th</sup> five-year plan for national basic research development> associated with specific scientific and technological areas, such as drug development, medical technology, protein research, genome research etc. The NSFC totally funded 109 research projects, workshops and conferences during 2006 – 2010, ranging from analytical approaches and algorithm design for data mining to human diseases oriented research and etc ([isisn.nsf.gov.cn/egrantweb](http://isisn.nsf.gov.cn/egrantweb)). During the same period (2006-2008), the 863 programmes launched three calls for ‘Bioinformation and Computational Biological Technology’ under the scheme of biology and medical technology, and invested 165 million RMB (approximately 16.5 million GBP) to funded 89 research projects. Likewise, these projects were not limited to infrastructure building and bioinformatics technology development, but cover application-oriented research, including medical equipment design and development, personalised medicine, drug development, disease related research and etc (Ai and Wang, 2011). In addition, the MOST launched a new scheme of New Drug Creation and Development (2008-2020) in National Science and Technology Major Project. Apart from traditional chemical drugs, biopharmaceuticals and traditional Chinese medicine (TCM) are also covered by this scheme. The development of biopharmaceuticals and modern TCM require bioinformatics technology to perform pathological analysis, for example, identifying drug targets, and/or pharmacological analysis on ingredients of TCM.

At the end of the 11<sup>th</sup> five-year period, bio-industry was identified as one of the seven strategic emerging industries which helped China to improve national competitiveness. The state council of China promulgated two general industrial policies in 2009 and 2010 respectively, i.e. <Some Policies Promoting the Development of Bio-industry> and

<Decision of the State Council on Accelerating the Fostering and Development of Strategic Emerging Industries>, which clearly state the role of bioinformatics for some sectors of bio-industry. The National Key R&D Technology Programme of MOST also invested 30 million RMB (approximately 3 million GBP) for three three-year (2008-2010) projects that have direct links to bio-industry, i.e. ‘the Development of Database for Bio-technology and Industrial Information’, ‘the Standardisation, Integration and Application of Bio-technology and Industrial Information’ and ‘Grid-based Key Technology and Software for Bioinformation’.

In the era of Big Data, bioinformation data, medical data and bioinformatics technology are becoming more meaningful than ever in scientific research, technology development, product R&D and healthcare service provision. However, China lacks a national centre for bioinformation like the US National Centre for Biotechnology Information (NCBI), European Bioinformatics Institute (EBI) and DNA Data Bank of Japan (DDBJ) which collect biological data across countries. As mentioned in <12<sup>th</sup> five-year plan for biological technology>, the Chinese government put the establishment of national centre for bioinformation on its agenda, to collect data of genomics, proteomics, metabolomics, human genetic resources, clinical resources and etc. During the 12<sup>th</sup> five-year plan, bioinformatics was identified as a basic approach for the understanding of new drug discovery and personalised medicine as stated in <12<sup>th</sup> five-year plan for National Foundation of China> and <12<sup>th</sup> five-year plan for medical technology>. In 2012, the state council issued a <Notice of the State Council on Issuing the Bio-Industry Development Plan> which indicates that government policy would extend from the science and technology development to the service market. The Chinese government, on one hand, planned to cultivate a market for gene therapy, clinical gene diagnosis and personalised medicine and, generate a bioinformation service oriented market for the biological industry; on the other hand, a commitment to providing healthcare service by adopting information technology (please see 12<sup>th</sup> five-year plan for science and technology development). In response to the later decision of government, the MOST supported ‘Research on Key Technology and Demonstration of National Digital Health’ by The National Key Technology R&D Programme, which enables the ability to create and manage the clinical history of patients and prescriptions in electronic format. This system has been applied in some general hospitals of eight provinces (<http://www.mrsta.com/Html/chengguozhanshi/90811.html>). Furthermore, the most recent 863 programmes for 2015 includes a scheme of ‘key technology of biological big data development and application’ under the category of ‘Biomanufacture and Bioproduct’. One of the main tasks of this scheme is to support healthcare service provision by integrating big data of patient history, clinical diagnosis data, disease data, analytical tools and system, etc.

## Reference

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Table 1 S&T Policies

Name of Policy	Department and Year of Issue	Quotation
10 <sup>th</sup> five-year plan for science and technology development	The MOST, 2001	<p>1. High-Tech R&amp;D (2) Biology Technology</p> <p>Based on the cutting-edge technologies of genetic manipulation and bioinformation, focusing on isolation, clone, structure and functions of functional genes; molecular design and drug screening, biochips...solving key problems in agricultural and medical area...</p>
10 <sup>th</sup> five-year plan for natural science foundation of China	The NSFC, 2001	<p>*RESEARCH BASED ON NATIONAL ADVANTAGES AND FEATURES</p> <p>Bioinformatics: analysis on information structure of human or other species genomes; research on genetic polymorphism of Chinese; comparative genomics research; and regulatory sequence analysis and regulatory mechanisms research.</p> <p>* PRIORITY FUNDING AREA</p> <p>1. scientific problem -oriented interdisciplinary research, including informatics in life sciences...</p>
Key support areas of national key basic research development programme (973 programme) for the last three years of 10 <sup>th</sup> five-year plan.	The MOST, 2003	<p>KEY RESEARCH AREA:</p> <p>1. Agriculture: according to the development of national economy and society, and the challenges raised by the entrance of WTO, the basic research of agricultural area includes genomics study on animal and plant, quality improvement of agricultural products...</p> <p>2. Population and health: research on functional genome and proteome...</p>

<p>The National Program for Sci-Tech Basic Conditions Platform Construction during the Year of 2004-2010</p>	<p>The MOST, 2004</p>	<p>* MAIN TASK</p> <p>1. Building up material and information systems by making technology standards, developing corresponding technologies, integrating and coordinating large-scale scientific equipments, scientific data, scientific and technological documents, and so forth.</p> <p>* KEY PLATFORM ESTABLISHMENT</p> <p>...</p> <p>3. Platform for scientific data share: (1) building up database by integrating and categorising data source generated by different industries and national science and technology plan. (2) integrating existing scientific database generated by public funded research projects and further establish centralised and distributed national scientific data clusters. Improving the capability of international scientific information exchange.</p> <p>...</p> <p>6. Platform for networked science and technology environment: (2) Drawing upon high-performance computing, building up data grid and computing grid in order for computing resource share.</p> <p>...</p>
<p>National Medium- and Long-Term Programme for Science and Technology Development (2006-2020)</p>	<p>The State Council, 2005</p>	<p>* BASIC RESEARCH</p> <p>1. The Development of Subject:</p> <p>...</p> <p>(2) Interdisciplinary subject and emerging subject</p> <p>Subject intersection between basic subjects, basic subject and applied subject, science and technology, natural science and social science normally leads to important scientific discovery and emergence of novel subjects. So it must be paid high attention.</p> <p>2. Cutting-edge Scientific Problem:</p> <p>(1) Quantitative study and system integration of life process.</p> <p>Main research: gene expression and regulation, functional genomics...bioinformatics, computational biology, systems biology...and so on.</p> <p>...</p>

		<p>3. Basic Research for National Strategy</p> <p>...</p> <p>(2) Scientific problem of crop genetic improvement and agricultural sustainable development. Main research: key research agricultural gene and functional genome, genetics for variety and new cultivar breeding... and so forth.</p> <p>...</p> <p>4. Key Scientific Research Project</p> <p>(1) Research on protein. Main research: transcriptomics, proteomics, metabonomics, structural biology, protein related computational biology and systems biology, research approach of protein and etc.</p> <p>...</p> <p>* KEY AREAS AND PREFERENTIAL TOPICS</p> <p>...</p> <p>8. Population and Health</p> <p>...</p> <p>(4) New drugs discovery and creation, and advanced medical equipments development.</p> <p>...</p> <p>* CUTTING-EDGE TECHNOLOGY</p> <p>1. Biological Technology</p> <p>(1) Technologies of target discovery. Target discovery is crucial for innovative drug development, biological diagnosis and biomedical technology. Main research: identification of key functional gene and its regulatory network in physiological and pathological process, identification of functions of genes associated with diseases, technology of target screening, and technology of innovative drug development.</p> <p>(2) Technologies of molecular design for drug, animal and plant. Main research: bioinformation analysis, integration and modelling technology of protein and cell, virtual technology of molecular design for drug, animal and plant...</p> <p>(3) Technologies of gene manipulation and protein engineering. Main research: technology of gene expression</p>
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		and its regulation...
11 <sup>th</sup> five-year plan for science and technology development	The MOST, 2006	<p>* MAIN MISSION</p> <p>1. National Science and Technology Major Project New Drug Creation and Development. Main research: chemical drug, new target identification of bio-drug and drug design... establishment of technological platform for modern traditional Chinese medicine...</p> <p>3. Cutting-edge Technology and Basic Research (1) Cutting-edge technology. Biological and medical technology: ...develop genomic and proteomic technology...Main research: ...key research on bioinformatics and bio-computational technology... (2) Cutting-edge scientific research. Main research: ... Quantitative study and system integration of life process, including gene expression and regulation, epigenetic, systems biology, evolutionary biology, and bioinformatics. ... 4. Development of S&amp;T Basic Conditions Platform and Sharing Mechanism (2) Development of S&amp;T basic conditions platform. ... Platform for scientific data: building up over 10 national centres for scientific data and 11 networks for scientific data share. ....</p>
11 <sup>th</sup> five-year plan for national basic research development	The MOST, 2006	<p>* MAIN MISSION</p> <p>1. Subject Development (1) Basic subject ... Biological science: ...strengthening support for emerging subjects, such as various omics, bioinformatics, systems biology, computational biology and etc. Facilitating interaction among biological science, mathematics, physics, chemistry, medicine, pharmacy, agriculture, informatics, and so on.</p>

		<p>...</p> <p>(2) Interdisciplinary subject</p> <p>...</p> <p>Informatics: ...supporting bioinformatics, quantum informatics...developing algorithm for genomic information structure and biological sequence comparison and assembly...</p> <p>2. Cutting-edge Scientific Area</p> <p>(1) Quantitative study and system integration of life process, including gene expression and regulation, functional omics, gene, RNA and protein integrated systems biology, evolutionary biology, bio-physics and bioinformatics.</p> <p>3. Key Area in Basic Research of National Strategy</p> <p>...</p> <p>(2) Basic scientific problem of crop genetic improvement and agricultural sustainable development. Main research: ...functional genomics associated with crop output and quality...</p> <p>4. Key Scientific Research Project</p> <p>(1) Proteomics. Main research: transcriptomics, proteomics, metabonomics, structural biology, protein related computational biology and systems biology, research approach of protein, chemical biology.</p>
11 <sup>th</sup> five-year plan for natural science foundation of China	The NSFC, 2006	<p>...</p> <p>* PREFERENTIAL AREA</p> <p>There are two categories of preferential area, one is the areas defined by seven divisions; the other category is 13 selected interdisciplinary areas.</p> <p>...</p> <p>Quantitative study and system integration of crucial behaviours during life process.</p> <p>...“</p>
11 <sup>th</sup> five-year plan for National Key Basic	The MOST, 2006	<p>* KEY AREA AND MAIN MISSION</p> <p>1. Basic Research for National Strategy</p> <p>(1) Agriculture. Main research: ...crop gene discovery and research on functional genome...</p>

<p>Research Development programme (973)</p>		<p>...</p> <p>2. Key Scientific Research Project</p> <p>(1) Protein research. Surrounding vital movement, mechanism and prevention of human diseases, and regulatory mechanism of biological character, conducting research on proteomic, systems biological and developing approach for protein study. Establishing national bases for protein research and forming research network in China. Conducting research on human liver proteomic and key protein expression and regulatory mechanism.</p> <p>...</p>
<p>12<sup>th</sup> five-year plan for science and technology development</p>	<p>The MOST, 2011</p>	<p>* TECHNOLOGY BREAKTHROUGH IN KEY AREA</p> <p>...</p> <p>3. Facilitating Innovation of Modern Service Industry</p> <p>(1) Strengthening technology integration and model innovation, developing knowledge and technology intensive service industry...Focusing on modern education, digital culture, digital medicine and healthcare...and etc...</p> <p>* BASIC SCIENCE AND CUTTING-EDGE TECHNOLOGY</p> <p>1. Strengthening Basic Research</p> <p>(1) Promotion of interdisciplinary subject...Strengthening subject intersection between basic subjects, basic subject and applied subject, science and technology, natural science and social science; supporting the development of medicine, nanotechnology, bioinformatics and so forth.....</p> <p>...</p> <p>(4) Facilitating key scientific research plan by concentrating resources...Launching six key scientific research plan for protein research...and stem cell research... Key scientific research plan for protein research: structural biology, proteomics, novel technology and approach development, protein synthesis and degradation and regulatory mechanism, study on functional biology of protein, systems biology and synthetic biology, other basic research of protein.</p> <p>...</p> <p>2. Strengthening Cutting-edge Technology R&amp;D</p> <p>...</p>

		<p>(2) Biological and medical technology. Focusing on research on genomics and next generation sequencing technology, proteomic technology, stem cell technology, biosynthetic technology, biotherapeutical technology, molecular diagnostics technology, bioinformatics technology, target discovery and molecular design technology in drug...Establishing platform for gene sequencing, proteomics and translational medicine...</p> <p>...</p> <p>(8) Morden agricultural technology. Developing cutting-edge technology for functional genome sequencing of crop...target discovery and molecular design for drug...</p> <p>...</p>
12 <sup>th</sup> five-year plan for key scientific research plan for protein research	The MOST, 2012	<p>* MAIN MISSION</p> <p>...</p> <p>2. Proteomics</p> <p>...</p> <p>Research on computational biology based on proteomics data...developing support system by integrating omics database, analysis function, and network service, and developing software for drug target screening and disease biomarker discovery.</p> <p>...</p> <p>...</p>
12 <sup>th</sup> five-year plan for key scientific research plan for development and reproduction	The MOST, 2012	<p>* MAIN MISSION</p> <p>1. Embryonic and Organ Development</p> <p>(1) Features and rules of development process... dawning upon data of genome, transcriptome, proteome...exploring features and rules of development process. Developing computational biology based technology and approach for development. Building up mathematical model and experimental verification system for development process</p> <p>...</p> <p>(10) The impact of abnormal gene and environment factor on tissue and organ development and its related</p>

		<p>severe diseases. Discovering severe diseases related gene in the development of tissue and organ...</p> <p>...</p> <p>3. Basic Research on Severe Diseases Related to Reproduction and Development.</p> <p>...</p> <p>(4) Biological knowledge of tissue and organ degeneration...research on gene therapy for degeneration...</p> <p>...</p> <p>4. Establishment of Platform and System for Reproduction and Development Research.</p> <p>...</p> <p>(4) Animal model. Research on genomics, transcriptomics, metabolomics and immunomics based on pig and monkey...</p> <p>(5) Innovation and integration of animal gene modification technology. Developing novel technology for gene modification and gene mining based on pig...Conducting research molecular mechanism of new gene and key functional gene of animal...</p> <p>...</p>
<p>12<sup>th</sup> five-year plan for key scientific research plan for stem cell</p>	<p>The MOST, 2012</p>	<p>* MAIN MISSION</p> <p>1. Cell Reprogramming.</p> <p>...</p> <p>Regulatory mechanism of cell reprogramming. Conducting research on gene expression, protein expression..., and then improve efficiency of reprogramming.</p> <p>...</p> <p>2. Mechanism of Stem Cell Self-renewal and Pluripotent Maintenance and Culture of Pluripotent Stem Cell for New Species</p> <p>...</p> <p>...Comparing gene expression and protein express of stem cell from difference sources and at different development stages...</p>

		<p>...</p> <p>3. Directional Differentiation and Regulatory Mechanism of Stem Cell  ...Establishing mathematical model of stem cell differentiation by using computational biology, system biology and so forth...</p> <p>...</p> <p>6. Plant Cell Totipotency and Organogenesis</p> <p>...</p> <p>Plant stem cell and development. Differentiating plant stem cell in different species and parts by adopting molecular biology, biochemistry, functional genomics, culture in vitro technology and vivo tracing technology. Identifying key stem cell and its gene in the process of plant organ development...</p> <p>Regulatory mechanism of plant stem cell maintenance and differentiation. Conducting research on the relationship among environmental factor, hormone and genetic factor in plant stem cell maintenance and differentiation, and discovering novel approach to regulate gene by using epigenetics, genomics and bioinformatics.</p>
12 <sup>th</sup> five-year plan for national basic research development	The MOST and NSFC, 2012	* MAIN MISSION 1. Subject Development ... Biology:...Paying attention to interdisciplinary subject and emerging subject, like biophysics, bioinformatics, system biology...and tissue engineering. ... 2. Cutting-edge Science (1) Quantitative study and system integration of life process. Main research: gene expression and regulation, functional genomics...bioinformatics, computational biology, systems biology...and so on.

<p>12<sup>th</sup> five-year plan for bio-technology development</p>	<p>The MOST, 2011</p>	<p>* TREND AND DEMAND</p> <p>...</p> <p>4. Biotechnology will become the solution of human diseases...In the healthcare, 4P (preventive, predictive, personalised and participatory ) medicine will replace traditional diagnostic and therapeutic ways of medicine, the technology of high throughput screening, omics and bioinformatics will provide new approach for preventive and personalised medicine.</p> <p>...</p> <p>* MAIN TASK</p> <p>...</p> <p>2. Key Technology</p> <p>(1). Omics technology. Developing new generation sequencing technology based on which facilities technology of genome, transcriptome, proteome, metabolome, structural genomics and etc. Developing high throughout based technology of medial data analysis and data mining, sample analysis...and large volume data analysis...Promoting application of omics technology and bioinformatics technology in disease prevention and control, clinical diagnosis and therapy, new drug creation and development, etc.</p> <p>...</p> <p>(3). Bioinformatics technology. Developing key technology of computation, design, assembly and application of biological regulatory element. Developing search engine for individual and group genome and personalised information, and analytical technology of new-generated biological data. Conducting research on disease risk analysis, disease diagnostic and therapeutic model and system based on individual omic data. Research on technology of data mining and analysis for crop abiotic stresses. Establishing national platform of data integration, share and management for life sciences and medical technology.</p> <p>...</p> <p>(6) Technology of molecular typing and personalised medicine</p> <p>Research on technology of molecular typing and early diagnosis for severe disease and common disease.</p>
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		<p>Establishing standardised database of clinical data and sample data and information system. Research on technology of genome-wide association study for severe disease...novel approach of personalised medicine for severe disease.</p> <p>(10) Drug target discovery and molecular design. Research on systems biology based technology of drug target network analysis, protein function of target and biological active conformation modelling...technology of multi-targets design for drug ...technology of network pharmacology...</p> <p>...</p> <p>4. Strengthening Innovation Capability of Biological Technology</p> <p>(1). Establishing several national key laboratory and national centre of engineering technology. Establishing national key laboratory for stem cell and regenerative medicine, bioinformatics technology, synthetic biology, computational biology, systems biology and etc...</p> <p>...</p> <p>(3). Establishing national infrastructure of bioinformatics science and technology-national centre for bioinformation, including databases of national biological technology information, genome, proteome, metabolome...</p> <p>...</p> <p>...</p>
<p>12<sup>th</sup> five-year plan for natural science foundation of China</p>	<p>The NSFC, 2011</p>	<p>* SUBJECT DEVELOPMENT</p> <p>...</p> <p>2.Strategy of Subject Development.</p> <p>...</p> <p>Biology:...In the future 5 years...pay attention to biophysics, bioinformatics, systems biology...supporting research on biological phenomena and life activity at molecular, gene, protein, cell, tissue and organ, individual, group level by drawing upon findings of genomics, proteomics and bioinformatics...</p> <p>...</p> <p>...</p>

		<p><b>* KEY AREAS</b></p> <p><b>Priority Area of Divisions</b></p> <p>...</p> <p>2.Division of Chemical Sciences.</p> <p>...</p> <p>(8) Chemical and biomedical interdisciplinary research. Main research... novel approach and novel technology of information acquisition of biological system:...computer simulation technology, in particular computational technology of complex biological network system.</p> <p>...</p> <p>3.Division Life sciences</p> <p>(1) Technology of protein modification, identification and regulation...</p> <p>...</p> <p>(7) Complex traits genetic network and genetic development. Main research: structure analysis of complex traits genetic and genomic system, regulation of complex traits genetic and genomic system, complex traits Genome-wide association study...</p> <p>(8) System development and molecular evolution. Main Research:...evolution of gene and genome...</p> <p>...</p> <p>(11) Genetic network analysis of key crops. Main research: molecular genetic mechanism and genomic regulation network analysis of key crops; interaction between genes and interaction between gene and environmental factor...</p> <p>...</p> <p>...</p> <p>8. Division of Medical Sciences</p> <p>...</p> <p>(3) Basic research on pathogenesis, development, prevention of tumor and novel therapy. Main research: study on biomarker...and new target discovery.</p>
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Table 2 Industrial Policies

Name of Policy	Department and Year of Issue	Quotation
Some Policies Promoting the Development of Bio-industry	The State Council, 2009	<p>* STRENGTHENING PROTECTION OF GENETIC RESOURCE AND REGULATION OF BIO-SECURITY</p> <p>28. Strengthening Protection of Genetic Resource...Establishing information system of genetic resource...</p> <p>...</p> <p>...</p>
Decision of the State Council on Accelerating the Fostering and Development of	The State Council, 2010	<p>...</p> <p>* THE DEVELOPMENT OF KEY AREA</p> <p>3. Biological Industry. R&amp;D on biomedicine for prevention and treatment of severe disease...</p> <p>...</p> <p>...</p>

Strategic Emerging Industries		
12 <sup>th</sup> five-year plan for S&T of medical equipment manufacture industry	The MOST, 2011	<p>* KEY AREA</p> <p>2. Key Technology</p> <p>(1) Theory and approach. Research on new theory and novel approach drawing upon recent findings of basic medicine, bio-chemistry, informatics, electronics...</p> <p>...</p> <p>(3) Service. Developing novel service-oriented technology of digital healthcare, mobile healthcare and distance health care by recent findings of informatics, bioinformatics, network communication, the Internet of things, cloud and so forth...</p> <p>...</p> <p>...</p>
12 <sup>th</sup> five-year plan for medical and pharmaceutical industry	The Ministry of Industry and Information Technology, 2012	<p>* MAIN TASK</p> <p>9. Developing Informazation of Medical and Pharmaceutical Industry</p> <p>Strengthening the application of information technology in R&amp;D of product. Establishing IT based platform of new drug development and facilitating new drug development by applying computing technology in drug target screening, drug molecular design, drug screening, early evaluation of drug...Developing network and IT based medical equipment and making standardisation support distance medicine and medical resource share.</p> <p>...</p> <p>...</p>
Notice of the State Council on Issuing Development	The State Council, 2012	<p>* KEY AREA AND MAIN TASK</p> <p>1. Improving Competitiveness of Biomedical Industry</p> <p>(1) Supporting biomedical drug creation and commercialisation... Establishment of support system. Associated with National Science and Technology Major Project, establishing national bank of human severe</p>

<p>Plan for Bio-industry</p>		<p>disease related gene, and bank of bacterial strain, cell and virus strain supporting biomedical development and test. Establishing platform for cell expression and commercialisation of biomedicine R&amp;D...</p> <p>...</p> <p>(3) Standardisation for traditional Chinese medicine... Establishment of support system. Establishing gene bank of common material...</p> <p>...</p> <p>3. Improving Competitiveness of Bio-agriculture Industry</p> <p>(1)...Establishment of support system. Building up gene bank of agriculture and forestry...</p> <p>...</p> <p>...</p> <p>7. Cultivating Bio-Service Market Responding to Market Demand</p> <p>Launching bioinformation plan, cultivating enterprises for gene sequencing, diagnosis and bioinformation provision. Developing business of healthcare management, translational medicine, cell therapy, gene therapy, clinical diagnosis, personalised medicine, etc...</p> <p>Bioinformation plan. Establishing service system of national biological resource and bioinformatics technology, cultivating capability of bio-industry oriented information service. Key technology development: Developing large-scale and high throughout gene sequencing technology and equipment, and large volume bioinformation process and analysis technology. Public service platform: Building up large scale platform of bio-resource bank and bioinformation centre, establishing networked national infrastructure of bio-resource and bioinformation for service provision, strengthening data mining of genetic information and developing novel sequencing equipment. Providing bioinformation for personalised medicine, bio-resource mining...and so forth.</p>
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Table 3. Funding Schemes

Name of Policy	Department and Year of Issue	Quotation
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<p>2006 National 863 programme for biological and medical technology</p>	<p>The MOST, 2006</p>	<p><b>* BIOINFORMATION AND COMPUTATIONAL BIOLOGICAL TECHNOLOGY</b></p> <p>This category is aiming at the cutting-edge technology of international bioinformation and computational biological and the demand of Chinese life sciences and bio-technology development. The mission is to establish and/or improve bioinformation share, service and technology supporting system and IT system of new drug creation; to develop novel approach, novel technology of bioinformation analysis, computational biology and systems biology; to develop bioinformation software product; to develop the key bioinformatics and computational biological technology of drug information, genomics, proteomics, structural biology, biomarker discovery and target discovery. This category will provide heavily support to R&amp;D of key technology of computational biology and systems biology, bio-data integration and share, data mining of bioinformation, digital medicine, drug information, key biomarker discovery.</p> <p>In 2006, the budget of this category is 80 million RMB... This category plan to finance two types of project. One is research-oriented project, including technology of computational biology and systems biology, bio-data integration and share, bioinformation mining...; the other type is goal directed project, including bioinformation software R&amp;D, technology of drug information, key biomarker discovery, digital medicine and so forth...</p>
<p>2007 National 863 programme for biological and medical technology</p>	<p>The MOST, 2007</p>	<p><b>* BIOINFORMATION AND COMPUTATIONAL BIOLOGICAL TECHNOLOGY</b></p> <p>This category is aiming at the cutting-edge technology of international bioinformation and computational biological and the demand of Chinese life sciences and bio-technology development. The mission is to establish and/or improve bioinformation share, service and technology supporting system and IT system of new drug creation; to develop novel approach, novel technology of bioinformation analysis, computational biology and systems biology; to develop bioinformation software product; to develop the key bioinformatics and computational biological technology of drug information, genomics, proteomics, structural biology, biomark discovery and target discovery..</p> <p>In 2007, the budget of this category is 65 million RMB... This category plan to finance two types of project. One is research-oriented project, including technology of computational biology and systems biology, drug information, neural information and etc...; the other type is goal directed project, including bioinformation software R&amp;D,</p>

		technology of micro functional genetic bioinformation and translational medicine relevant information integration and application, and so forth...
2008 National 863 programme for biological and medical technology	The MOST, 2008	<p><b>* BIOINFORMATION AND COMPUTATIONAL BIOLOGICAL TECHNOLOGY</b></p> <p>This category is aiming at the cutting-edge technology of international bioinformation and computational biological and the demand of Chinese life sciences and bio-technology development and focuses on neural information process software and self-control intelligent system, development of neural interface and human-computer interaction based feel and activity auxiliary equipment and information system, development of large scale bioinformation software with independent intellectual property rights, establishment of large scale database of key resource and information for biological and medical technology R&amp;D...</p> <p>In 2008, the budget of this category is 20 million RMB... This category plan to finance two types of project. One is research on neural information technology...; the other is research on product R&amp;D of bioinformation technology...</p>
11 <sup>th</sup> five-year national key technology R&D plan: key technology development and demonstration of public information share and exchange for biotechnology industry	The MOST, 2008	<p><b>* SCOPE AND GOAL</b></p> <p>The main mission of this plan is to collect, categorise and apply existing bioinformation and bio-data, and to establish world class technology platform and supporting system by using information of life sciences, biology, biological industry, bio-resource as bases, adopting bioinformation standardisation and network as methods...to facilitate the development of biological industry and technology, and to provide consultant service for policy-making of biological technology and industry development.</p> <p><b>* TIMEFRAME</b> 2008-2010</p> <p><b>* CATEGORIES</b></p> <ol style="list-style-type: none"> <li>1. The Design and Construction of Platform of Biological Technology and Industrial Information Share...Budget is 15 million RMB...</li> <li>2. Standardisation, Integration and Application of Biotechnology and Industrial Information... Budget is 9 million RMB...</li> </ol>

		3. Grid Based Technology and Software Product of Bioinformation. ... Budget is 6 million RMB...
11 <sup>th</sup> five-year National 863 programme for biological and medical technology: genome-wide association study and pharmacogenomics study on common severe diseases	The MOST, 2008	<p>* SCOPE AND GOAL</p> <p>This plan has 9 projects focusing on mental disorder, hypertension, diabetes, lung cancer and esophageal cancer, which are to research genome-wide association study and pharmacogenomics study of genetic mechanism and pathogenesis, and efficacy and safety of drug therapy. Two projects are to serve the research on above 5 diseases by establishing technology platform for genome-wide association study and pharmacogenomics study; five projects are to focus on the genome-wide association study and pharmacogenomics study of 5 diseases respectively; one project is to investigate genetic mutation associated with severe disease by using novel sequencing technology; the last project is to build up information platform for information management and sample management.</p> <p>This plan starts from Jan 2009 to Dec 2010. The total budget is 200 million RMB.</p>
2014 National 863 programme for biological and medical technology	The MOST, 2013	<p>* CUTTING-EDGE BIOLOGICAL TECHNOLOGY</p> <ol style="list-style-type: none"> <li>1. Protein Sequencing Equipment and Reagent...8 projects with 80 million RMB...</li> <li>2. The Development of Key Technology for Identifying Metabolome and non-coding RNA...4 projects with 40 million RMB...</li> <li>3 Integration and Key Technology R&amp;D of Microbe Information Systems...4 projects with 40 million RMB...</li> </ol> <p>* BIOMEDICAL TECHNOLOGY</p> <ol style="list-style-type: none"> <li>1. Clinical Information Based Research on Tumor Molecular Network and Key Technology R&amp;D...9 projects with 80 million RMB...</li> </ol> <p>...</p> <p>...</p>
2014 National 863 programme	The MOST, 2014	<p>* BIOLOGICAL AND MEDICAL TECHNOLOGY</p> <ol style="list-style-type: none"> <li>1. Biomanufacture and Bioproduct. <ol style="list-style-type: none"> <li>(1) Research on key technology of biological big data development and application. There are 5 research</li> </ol> </li> </ol>

		<p>topics: a) <b>Biological big data standardisation and integration technology</b>. Research on integration technology of omics data, clinical data and healthcare data, R&amp;D on information model and integration engine of omics data, clinical data and healthcare data...; b) <b>Index, search, storage and access technology of biological big data</b>. Research on parallels access technology of biological big data, development of high efficiency index technology, and reliable and scalable storage technology of biological big data, search technology of big data...; c) <b>Research on disease big data analysis and application linking to cardiovascular disease and tumor</b>. Research on technology of big data process, storage, analysis and application by integrating patient history, image, clinical diagnosis data (covering 500 thousand or above individuals and generating about 50 TB data)...; d) <b>Research on regional medical and healthcare big data process, analysis and application</b>. Covering 1 million or above individuals and generating no less than 100 TB regional medical and healthcare data. Establishing healthcare oriented support platform and providing service...; e) <b>Establishment of data centre for omics and research on technology of service provision</b>. The centre will integrate no less than 100 TB data of omics, such as genomics, proteomics, etc. and provide open access for at least 60% data...Building up visual analytical platform for omics big data searching and mining.</p> <p>...</p> <p>...</p> <p>...</p>
<p>Second call for 11<sup>th</sup> five-year plan National Science and Technology Major Project: New Drug Creation and Development (2009-2010)</p>	<p>The MOST, 2008</p>	<p>* SCOPE AND CONTENT</p> <p>...</p> <p>2.Public Resource Platform of New Drug R&amp;D.</p> <p>(1) Comprehensive technology platform of new drug R&amp;D...Main task: ... establish integrated research system of new target identification, new drug design, high efficient drug screening...for drug discovery...Budget: no more than 200 million RMB each project and this plan supports 8-10 projects.</p> <p>(2) Technology platform of drug screening...Main task: Research on identification and verification of drug target by using approach and technology of molecular pharmacology, molecular biology, systems biology, genomics, proteomics, etc,...Budget: no more than 40 million RMB each project and this plan supports no more</p>

		<p>than 4 projects.</p> <p>...</p> <p>...</p> <p>4.Key Technology of New Drug R&amp;D</p> <p>...</p> <p>(3) Key technology of biodrug R&amp;D. ..a) <b>Key technology of functional gene based biodrug R&amp;D</b>...providing source of innovation by identifying new gene and protein, developing new genetic engineering drug, identifying drug target, genetic target for gene therapy, etc...; b) <b>Key technology of biodrug design</b>...developing biodrug design and screening technology by using findings of genomics and molecular biology...</p> <p>...</p>
2011 National Science and Technology Major Project: New Drug Creation and Development	The MOST, 2010	<p>* SCOPE AND CONTENT</p> <p>...</p> <p>7. Public Resource Platform of New Drug R&amp;D</p> <p>(1) Bank and database of clinical samples...Main task: building up clinical database and clinical sample bank for four severe disease, i.e. therioma, cardiovascular disease, mental disorder and metabolic disease...Budget: 10-15 million RMB each project and this plan supports no more than 4 projects.</p> <p>(2) Bank of chemical composition of traditional Chinese medicine...Main task:...database of chemical composition of traditional Chinese medicine, including chemical and biological information collection, categorisation, and mining, as well as software R&amp;D. Budget: 15-20 million RMB each project and this plan supports no more than 2 projects.</p> <p>...</p>
2012 National Science and Technology Major Project: New Drug	The MOST, 2011	<p>* SCOPE AND CONTENT</p> <p>1. Innovative Drug R&amp;D</p> <p>...</p> <p>(3) Biodrug. Supporting...new carrier, new target...based innovative drug R&amp;D...</p>

<p>Creation and Development</p>		<p>...</p> <p>...</p> <p>3. Key Technology of Novel Drug R&amp;D</p> <p>(1) Key technology of druggability evaluation in early stage...Main research: to build up efficient evaluation system, this plan supports study on novel technology and novel method for the evaluation of drug efficacy and pharmacokinetics in early stagey by drawing upon the findings of genomics, biochip, bioinformation, etc...</p> <p>(2) Key technology of network pharmacology and software product...Main research: to establish system of new drug discovery and efficacy evaluation and develop analytical software, this plan supports research on novel technology and novel approach of network pharmacology by using findings of biological network, disease-gene or protein-protein network, drug-target network, etc...</p> <p>...</p> <p>(7). Key technology of the identification of biomarkers for personalised medicine and its assay kit R&amp;D...Main research: research on the identification of biomarkers associated with drug efficacy....by using findings of pharmacogenomics, genome-wide association study, etc...</p>
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