SENET-HUB
SINO-EUROPEAN HEALTH NETWORKING HUB

IC2PerMed

SINO-EUROPEAN HEALTH COLLABORATION WEEK

Personalised Medicine: A common health priority between EU and China

Friday, Dec. 3, 2021

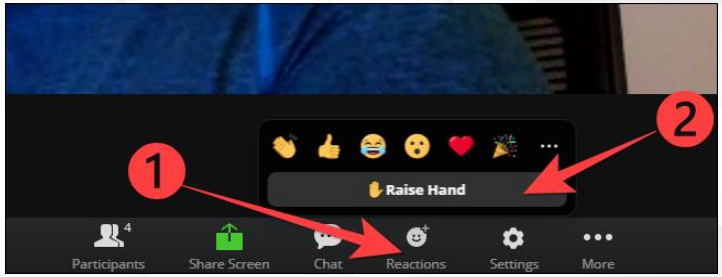
These projects have received funding from the European Union's Horizon 2020 research and innovation programme.

HOUSEKEEPING RULES

Please keep your microphone **muted**,

unless the speaker asks you to unmute

Please **raise your hand** (Zoom function), if you wish to speak



Smile! You are being recorded.

Recordings by participants are **allowed – and welcome!**

Sino-European Health Collaboration Week: project's partners

IC2PerMed

SENET-HUB
SINO-EUROPEAN HEALTH NETWORKING HUB

ENRICH
EUROPEAN NETWORK OF RESEARCH AND INNOVATION CENTRES AND HUBS, CHINA

精准医疗 SINO-EU PerMed
Cooperation between China and Europe in Personalised Medicine

euraxess
RESEARCHERS IN MOTION

IDIH
INTERNATIONAL COLLABORATION
DIGITAL TRANSFORMATION
HEALTHY AGEING

Sino-European Health Collaboration Week: Agenda

- Monday, 29. November 2021: State of play of Sino-European health collaboration | **SENET, IDIH**
- Tuesday, 30. November 2021: Facilitating Sino-European health collaboration | **SENET, EURAXESS**
- Wednesday, 1. December 2021: Health data, a Sino-European perspective | External event hosted by **IC2PerMed**
- Thursday, 2. December 2021: Market access for innovative health products | **ENRICH in China**
- Friday, 3. December 2021: Personalised Medicine, a common health priority between EU and China | **IC2PerMed, Sino-EU PerMed**

Agenda of the day

09:30 – 09:45: Introduction and presentation of the IC2PerMed's project
Speaker: Stefania Boccia (UCSC)

09:45 – 10:15: Policies and programmes in the field of Personalised Medicine in China and in Europe
Speaker: Flavia Beccia (UCSC)

10:15 – 10:30: Presentation of the Sino-EUPerMed's project
Speaker: Carolin Lange (DLR)

10:30 – 11:00: Mapping the technological and scientific Personalised Medicine landscape in Europe and China
Speaker: Gianni D'Errico (Fondazione Toscana Life Sciences)

11:00 – 11:30: China's perspective on the development of Personalised Medecine
Speaker: Prof. YANG Ji-Jiang (Tsinghua University)

11:30 – 12:00: Interactive Q&A session
Moderator: Carolin Lange (DLR)

12:00: End of the meeting

INTRODUCTION AND PRESENTATION OF THE IC2PERMED'S PROJECT

Prof. Stefania Boccia, Representative of the Italian Ministry of Health for 1+Million Genomes

Delegate of the Italian Ministry of University and Research for the Subgroup of health Promotion and Prevention on Cancer of the European Commission

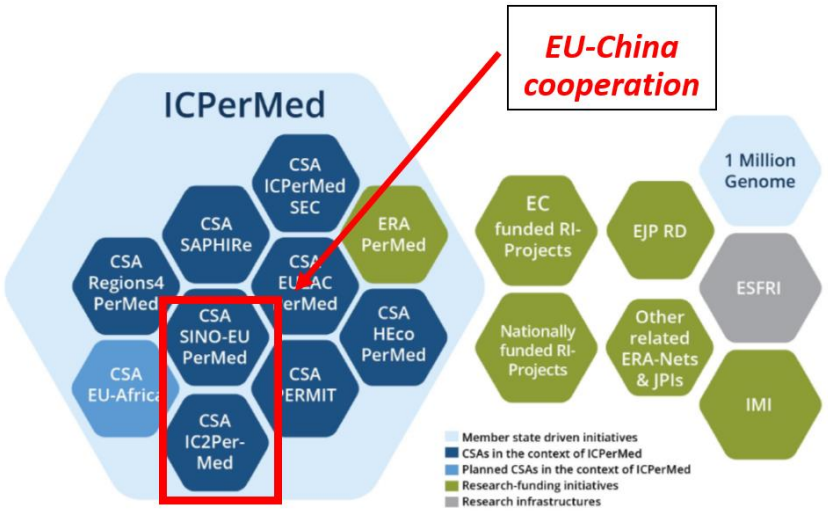
Section of Hygiene-Institute of Public Health
Università Cattolica del Sacro Cuore,
Fondazione Policlinico "A. Gemelli" IRCCS, Rome, Italy

9h30 – 9h45 CET
16:30 – 16:45 CST

The aim of the Project

Under the **ICPerMed initiative** (40 partners from 31 Countries), the EU-funded IC2PerMed project will provide key solutions to enable the **convergence of European and Chinese stakeholders** towards a common approach in PM, involving policymakers and healthcare beneficiaries.

Its vision is to become an efficient lever for supporting **EU-China collaboration** for the development of Personalized Medicine research and enabling populations to access **personalised, smart and inclusive healthcare solutions in the near future**.



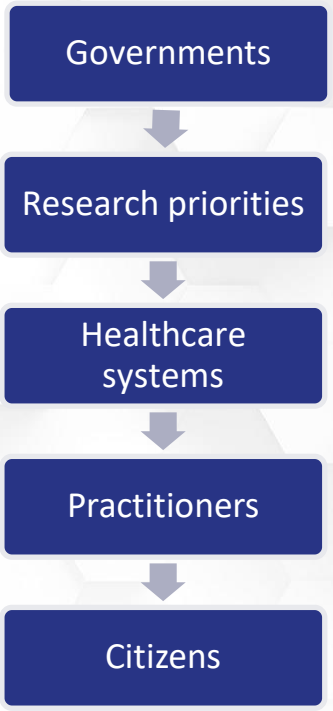
Project details and partners

IC2Permed is a **Coordination and Support Action (CSA)** project, funded from the European Commission in support of the ICPerMed network.

- European Union: Horizon 2020 CSA - Coordination and support action (SC1-HCO-01-2018-2019-2020)
- Starting Date : January 1st, 2020
- Duration : 48 months
- Consortium : 10 Partners

The Context

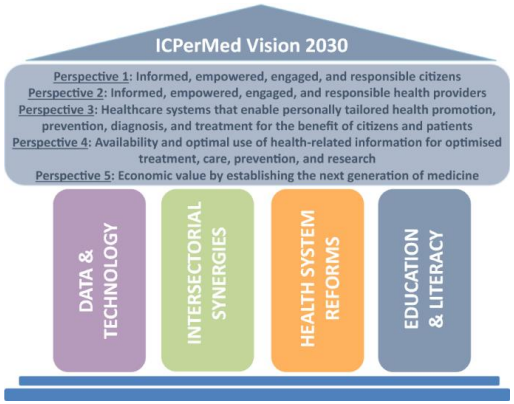
- Thanks to advances in biomedical and digital technologies, **Personalised Medicine (PM) improves healthcare** and underpins more **efficient and sustainable health systems**.
- **In China it is attracting massive interest,** with the government capitalising on its expertise in biotechnology, computing hardware and producing infrastructures for supporting bioinformatics projects.
- **Turning PM into an opportunity for citizens and patients** requires the engagement of stakeholders internationally **to define common research and development approaches**, standards and priorities. In order to respond to these challenges, the EU supports actions developed within the International Consortium for Personalised Medicine (ICPerMed).
- The EU-funded IC2PerMed project will provide key solutions for enabling the convergence under ICPerMed of European and Chinese stakeholders towards a common approach of PM, involving policymakers and healthcare beneficiaries.

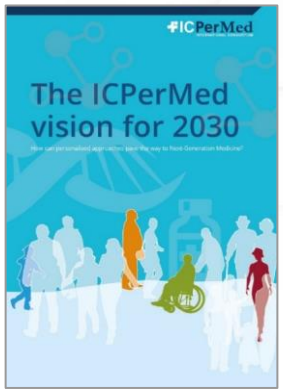


ICPerMed-International Consortium on Personalised Medicine

- Launched in 2016, now more than 40 European and international partners
- Members and observers are **public and private not-for-profit health research funding organisations**, representing ministries, funding agencies and the European Commission (EC)
- advancement of the biomedical, social, and economic sciences, together with technological development, is the driving force for PM. Strong investment in research and innovation is therefore a prerequisite for its successful implementation.

Aim: To coordinate and foster research to develop and evaluate personalised medicine approaches





The IC2Permed approach

01. Mapping

Identifying Chinese and EU appropriate policies, programmes, stakeholders and standards to consider and involve in developments; Envisioning benefits for healthcare ecosystems and benefits for populations

02. Expertising

Building upon exchanges between experts in PM domains for fostering actionable approaches

ICPerMed
INTERNATIONAL CONSORTIUM

03. Exemplifying

Setting concrete practices of successful collaboration over a PM core thematic (biobanks) for illustrating and inspiring research collaborations

04. Engaging

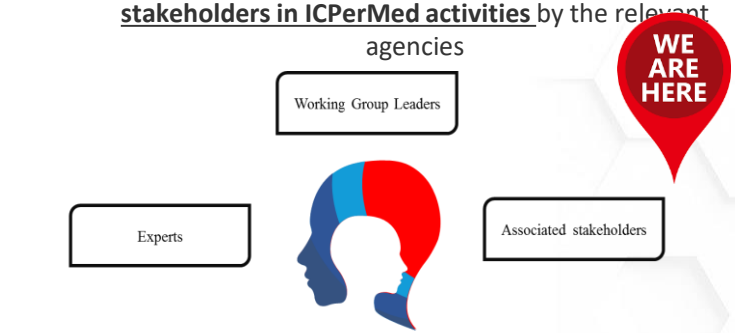
Creating strong bridges with key stakeholders from the EU, China and beyond, integrating Chinese stakeholder in ICPerMed and liaising with international peers

At the end of Year 2 out of 4: where are we?

Mapping of Personalised Medicine's policies and programmes in Europe and China

Working groups:

Community of EU and Chinese PM stakeholders analysing and **designing a roadmap for developments upon PM R&I schemes for facilitating the integration of Chinese stakeholders in ICPerMed activities** by the relevant agencies



Delegation visits

Creating a solid framework for collaboration formalising engagement of relevant Chinese stakeholders within the ICPerMed initiative

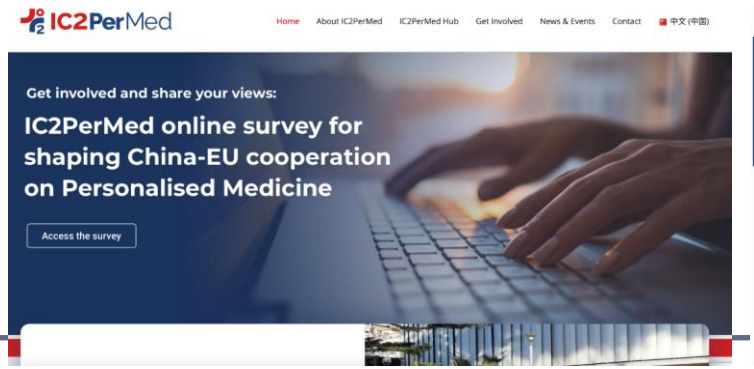
IC2PerMed developments

1) **Mapping of Personalised Medicine**'s policies, programs, standards and initiatives for the adoption of Personalised medicine in Europe and China

Outputs:

- ❑ 3 public deliverables
- ❑ 5 scientific papers to be published in academic journals
- ❑ 2 abstracts presented at 2021 Congress of the Italian Society of Hygiene Preventive Medicine and Public Health: Health data, ICT and biobanking in personalized medicine: "A *comparative analysis between Europe and China"; "State of the art of the implementation of Personalized Medicine in Europe and China: the results of a survey among experts"* (transl. from Italian)

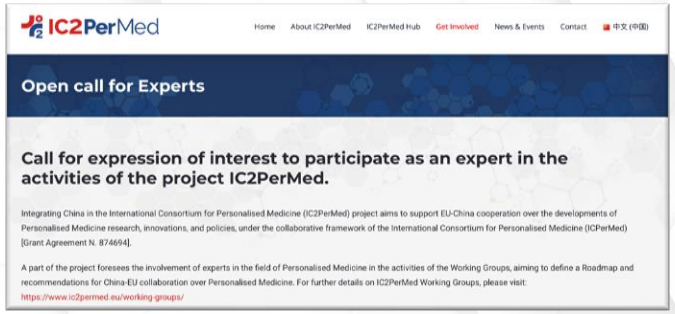
2) Set up of **bi-lingual website** in English and Chinese (https://www.ic2permed.eu/), twitter account (@Ic2PerMed) and joint publication of project newsletter with twin CSA Sino-EU-PerMed



IC2PerMed developments

3) Expert recruitment and engagement process

- **Top-Down approach:** Identification of **actively engaged experts in the field of PM implementation,** by screening latest reports, scientific publications, conference programs and workshops, funding projects etc. The final list was validated on behalf of the Consortium.
- **Bottom-up approach: 'Open call for experts':** Set-up of a webpage corresponds to an online questionnaire in which stakeholders were invited to provide information on their backgrounds and potential contributions to the Working Groups.
- **Two dissemination and engagement events repeated twice at different times** *(23rd November 2020 for EU public, 19th January 2021 for Chinese public) to:*
  - ❑ Establish working methodology with experts
  - ❑ Present and assess mapping results
  - ❑ Introduce experts to the IC2PerMed Survey for the validation of the mapping results



Expert Survey (Feb 2021)

Experts were asked to participate to a survey to validate the results of the mapping activities and to gain additional insights from experts

IC2PerMed

SURVEY TO FOSTER SINO-EUROPEAN COOPERATION IN PERSONALISED MEDICINE

Are you a European researcher in **Personalised Medicine** or adjacent field with experience in China? Take this short survey and give your feedback to support IC2PerMed (**Integrating China in the International Consortium for Personalised Medicine**) initiative to better understand the current situation of European researchers in China and to develop long-term strategies to strengthen Sino-European collaboration.

SURVEY METHODS AND RESULTS

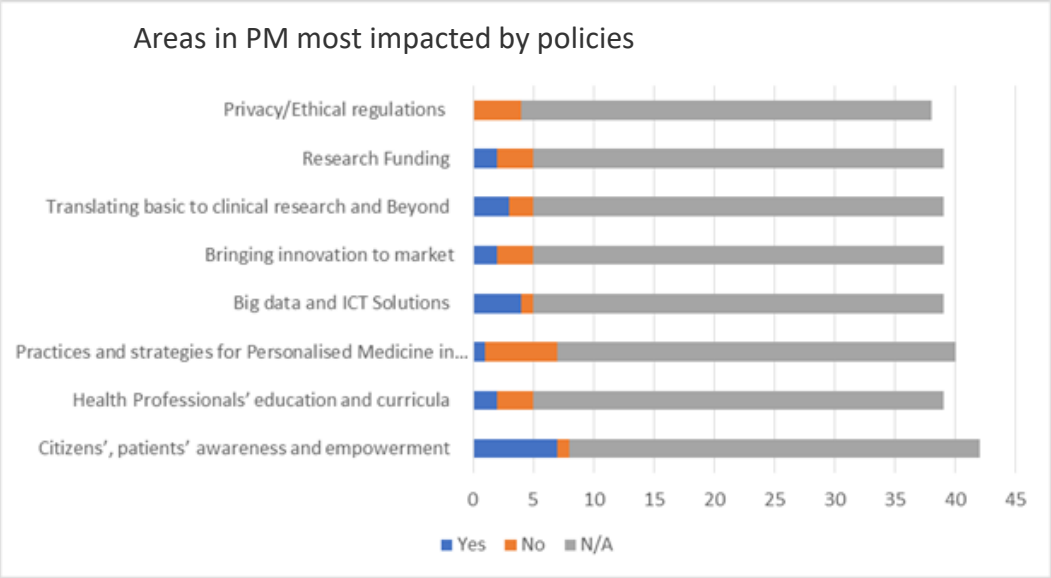
METHODS

- Survey developed by the IC2PerMed consortium and validated by a focus group of experts
- English and Chinese language
- LimeSurvey
- 29 January - 28 February 2021
- 19 questions in 4 sections:
  - Personal information (4 questions)
  - Policies in PM (7 questions)
  - Facilitating and hindering factors for Sino-European cooperation in PM (6 questions)
  - Working groups (2 questions)
- Results reported through descriptive statistics and qualitative data summary

RESULTS

- Experts who completed the survey:
  - 27 Europeans
  - 20 Chinese
- Only 4 participants were aware of the implementation of PM-related policies in their country of work.

Results (1/4)

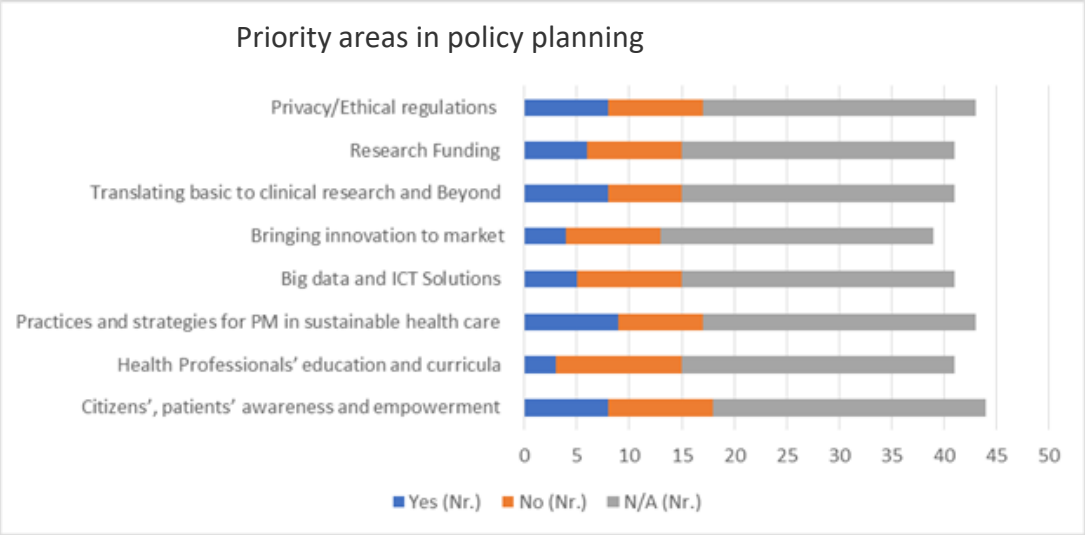


Areas in PM most impacted by policies

- Awareness and empowerment of citizens and patients
- Big data and ICT solutions
- Translational medicine

13 answers

Results (2/4)



Priority areas in policy planning

- Education of healthcare professionals
- Big Data and ICT solutions
- Transfer of innovation to the market
- Research funding
- Awareness and empowerment of citizens and patients

21 answers

Results (3/4)

Key barriers to policy planning, development, and implementation:
16 answers

- Integration between research/experimental set-up and routine clinical practice
- Lack of investments and funding strategies
- Education and curricula of healthcare professionals
- Citizen's awareness and empowerment

- Ethical aspects
- Language barriers
- Lack of funding
- Data infrastructure

Research priorities
16 answers

- Research on biomarkers
- Ethical aspects
- Complex diseases
- Rare diseases
- Preventive medicine
- Big data and biobanks

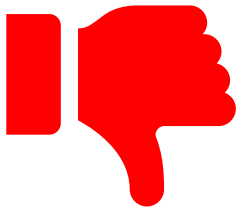
- Big data
- Healthcare system sustainability
- Cellular and gene therapy
- Basic research
- Digital health

Results (4/4)

Facilitators and barriers for a China-European collaboration

- Funding of bilateral activities
- Identification of common opportunities
- Shared research and funding platforms
- Knowledge/Personnel/idea -exchange frameworks

- Different political systems
- Ethnic differences
- Communication barriers (language, internet, media)
- Comprehension and public acceptance of PM's value
- Lack of knowledge-sharing
- Lack of consensus in the guidelines on the interpretation and use of PM



Discussion and conclusion

1. To achieve efficient and ***sustainable health systems***, implementing PM is the cornerstone of Public Health strategies.

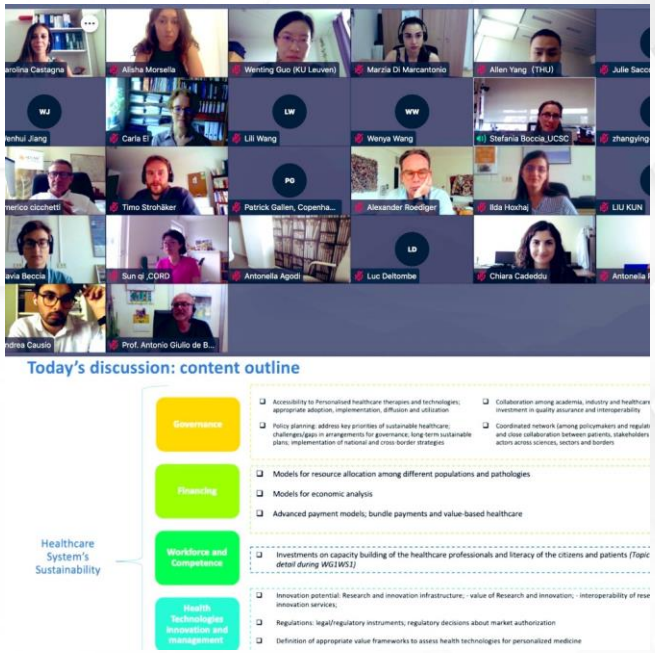
2. To transform PM into an opportunity for all citizens and patients, setting up a ***clear and integrated regulatory framework***, with the engagement of all stakeholders involved, is key to define common approaches, standards, and priorities for research and development, and to increase collaboration at the international level.

3. The results obtained from the survey aim to help define such common approaches, standards and priorities for R&D and to increase international collaboration and provide key solutions to enable ***convergence towards a common approach*** to PM research, innovation, development and implementation between the EU and China.

IC2PerMed developments

3) **Working Group topics dicussed**:

Working Group 1 – Shaping sustainable healthcare	Working Group 2 – Innovation and market	Working Group 3 – Research and clinical studies in Personalised Medicine
Chair: UCSC; Co-Chair: THU	**Chair: S2i; Co-Chair: BGI**	**Chair: FTELE; Co-Chair: NCC**
• Awareness and empowerment • Education and curricula • Personalised Medicine in sustainable healthcare	• Big data and ICT solutions • Bringing innovation to market	• Translating basic clinical research and beyond • Research Funding



Composition of Working Groups - expert's region of belonging:

→ *From China: 19*

→ *From Europe: 29*

→ *Total: 48*

IC2PerMed developments

Development of **onine Virtual Workshops** and release of 12 **double round Delphi Surveys** sent out to experts in English and Chinese, to confirm **priority setting**

	Workshop dates	In Europe [CET/CEST Time]	In China [CST Time]
WG1 - "Shaping Sustainable Healthcare"	I –March 25th (Thu)	9.30 to 11.30	16.30 to 18.30
	II –June 22nd (Tue)	9.30 to 11.30	15.30 to 17.30
	III – November 24th (Wed)	9.30 to 11.30	16.30 to 18.30

	Workshop dates	In Europe [CET/CEST Time]	In China [CST Time]
WG2 - "Innovation and Market"	I – March 29th (Mo)	9.30 to 11.30	15.30 to 17.30
	II – July 26th (Mo)	9.30 to 11.30	15.30 to 17.30
	III – November 23rd (Tue)	8.30 to 10.30	15.30 to 17.30

	Workshop dates	In Europe [CET/CEST Time]	In China [CST Time]
WG3 - "Research and Clinical studies in PM"	I – March 30th (Tue)	09.00 to 11.00	15.00 to 17.00
	II – June 24th (Thu)	09.00 to 11.00	15.00 to 17.00
	III – October 21st (Thu)	09.00 to 11.00	15.00 to 17.00

Synthesis of the WGs methodology

'Background documents', good practices and some guiding questions will be the inputs of our debates, but we are seeking **your views and perspectives** about the feasibility, appropriateness and sustainability of identified measures according to the specific social and healthcare context of EU and China.

2 two-round Delphi surveys for each WG (1 for each thematic) will circulate among you, in order to **validate WG outputs** and rank the priorities resulting from WG discussions according to their importance and relevance.

Results of the Delphi surveys will be presented to you by the WG coordinators during the third and last encounter for **feedback and fine-tuning of results**. This discussion will also provide a base for the validation of the Position Papers.

Final results will be used to elaborate a set **of 6 position papers** (2 for each WG - one for each challenge).

Next steps for the Roadmap release

- Position Paper's final versions will be discussed during one final **"Harmonisation/Alignment workshop"** that will be hosted virtually on **March 22nd or 24th (date tbc) from 9.00 to 13.00 (CEST)/ 16.00-19.00 (Beijing time)** and attended by all WGs. In this occasion, experts will further ensure that no critical area has been neglected and that the 6 Position Papers are in agreement.
- The six position papers will be synthesized in a logical sequence of actions that can be concretely undertaken and will be described in the "**IC2PerMed Roadmap**" to be discussed at the "IC2PerMed Roadmap Validation" workshop in **Rome, on 9th and 10th June** in order to make further adjustments and finalize the document
- The final version will then be presented at the "**Roadmap Presentation**" event in **Brussels, on September 21st**.

In parallel to WG activities: the IC2PerMed VRTs

BBMRI-ERIC®
Biobanking and BioMolecular resources Research Infrastructure

Ongoing '**Collaboration Framework of Biobank Infrastructure**': launch of 4 Virtual Round Tables on: Biobanking, ELSI, data and quality in November – Leader: BBMRI (Biobanking and Biomolecular Resources Research Infrastructure)

VRT#1: Biobanking – How does biobanking contribute to PM? ✔
Monday, November 29th , 2021

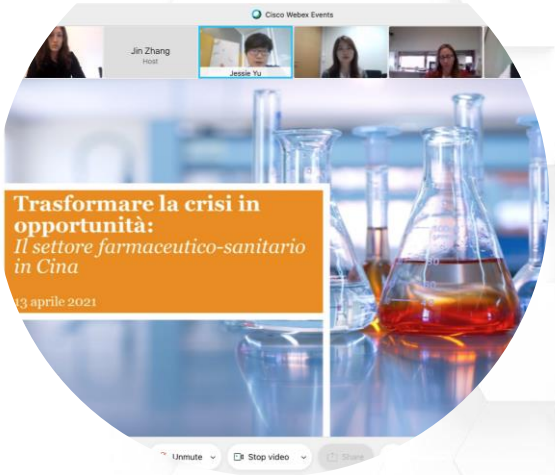
VRT#2: Data – It's all about data, isn't it? ✔
Wednesday, December 1, 2021

VRT#3: ELSI – Four letters – do they matter?
Wednesday, January 19, 2022

VRT#4: Quality – What's missing when things don't work as they should?
Wednesday, February 16, 2022

IC2PerMed's passed events

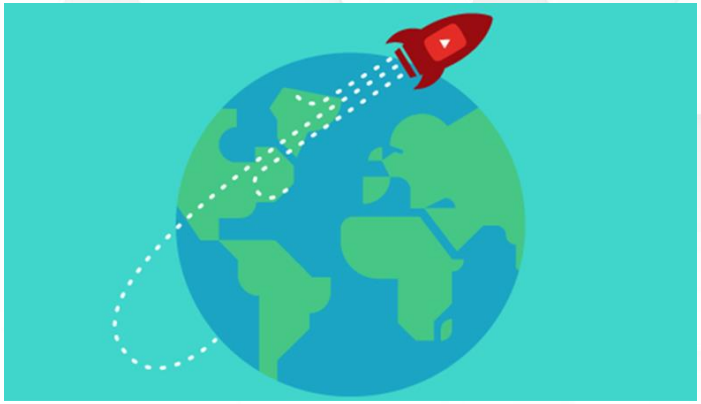
- Presentation of the Project at **Chinese Congress 2020 '3rd International Computational Law online forum**
- Presentation of the Project at 2 Sino-European **Health Networking Hub (SENET**) events
- Presentation of the Project at 1 Workshop by **PwC 'Turning Crisis into Opportunity**: Pharmaceutical-Healthcare sectors in China' - 13th April 2021



Scheduled as open

- **Two Global webinars orchestrated by the WFPHA:**
  - 24th March from 17.00 to 18.30 (CEST) "*Why we need PM in cancer: the case of the EU and China*"
  - 11th October from 16.00 to 17.30 (CEST): "*The IC2PerMed roadmap: best approaches to learn from each other and implement effective personalised medicine*".
- **International Symposium** held by WFPHA in 2023 (date tbd)
- **Delegation visits** to China in 2023

WFPHA



Thank you! / 谢谢！

UCSC team members:

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POLICIES AND PROGRAMMES IN THE FIELD OF PERSONALISED MEDICINE IN CHINA AND IN EUROPE

Flavia Beccia, Università Cattolica Del Sacro Cuore

9h45 – 10h15 CET Time

16:45 – 17:15 CST

IC2PerMed approach

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Identifying Chinese and EU appropriate policies, programmes, stakeholders and standards to consider and involve in developments; Envisioning benefits for healthcare ecosystems and benefits for populations

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ICPerMed
INTERNATIONAL CONSORTIUM

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Mapping of Personalised Medicine's policies and programmes in Europe and China

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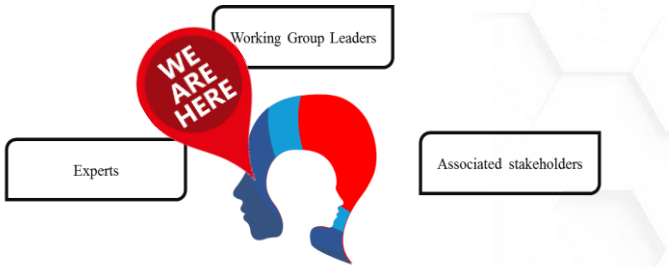

Working Group 1	Working Group 2	Working Group 3
Shaping sustainable healthcare	Innovation and Market	Research and Clinical Studies in PM

Delegation visits

Creating a solid framework for collaboration formalising engagement of relevant Chinese stakeholders within the ICPerMed initiative

WP1
MAPPING OF PERSONALIZED MEDICINE POLICIES AND PROGRAMMES IN EUROPE AND CHINA

- **Task 1.1** Mapping PM policies and programmes
- **Task 1.2** Mapping health research and innovation initiatives and stakeholders
- **Task 1.3** Mapping PM approaches and standards
- **Task 1.4** Assessment of current health research and innovation collaborations

❑ **Output of WP1:**

-D1.1. Scoping paper: Review on health research and innovation priorities in Europe and China

-D1.2. Map of major funding agencies and stakeholders in Europe and China

-D1.3. Mapping paper: Towards closer EU-China collaboration in PM

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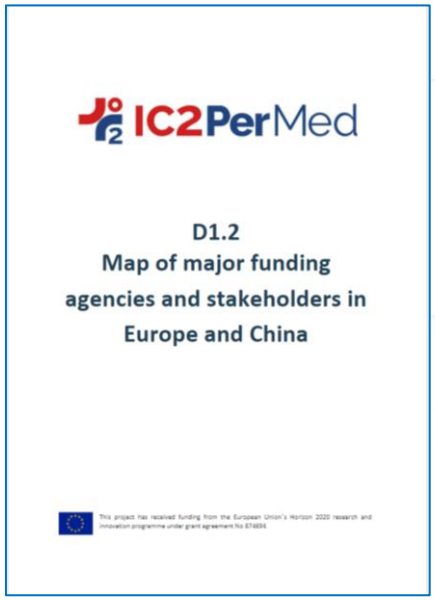
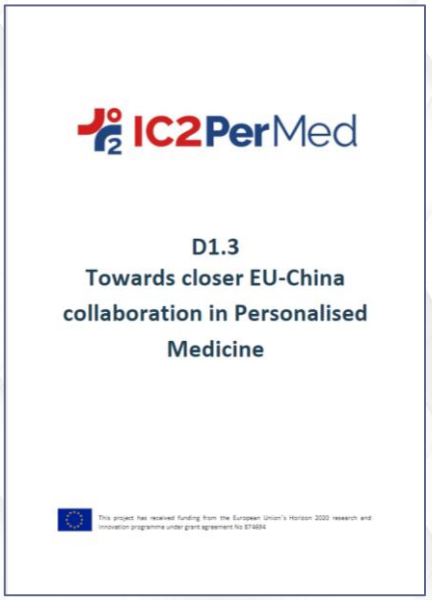
- Policy measures, programmes and action plans
- Comparative analysis of PM in Europe and China



- Policy agencies and PM stakeholders
- Funding schemes and programmes relevant for PM
- Existing and emerging initiatives
- Main research and innovation actors



- PM approaches and standards
- Data and biobanking standards
- Important technological co-developments
- How to achieve a closer cooperation between EU and China

Part I: Definitions of Personalized Medicine in Europe and China

Part II: Mapping of Personalized Medicine policies and programmes in Europe and China

Part III: Data acquisition and sharing in Personalized Medicine

Part IV: Research funding programmes on Personalized Medicine in Europe and China

Part I: Definitions of Personalized Medicine in Europe and China

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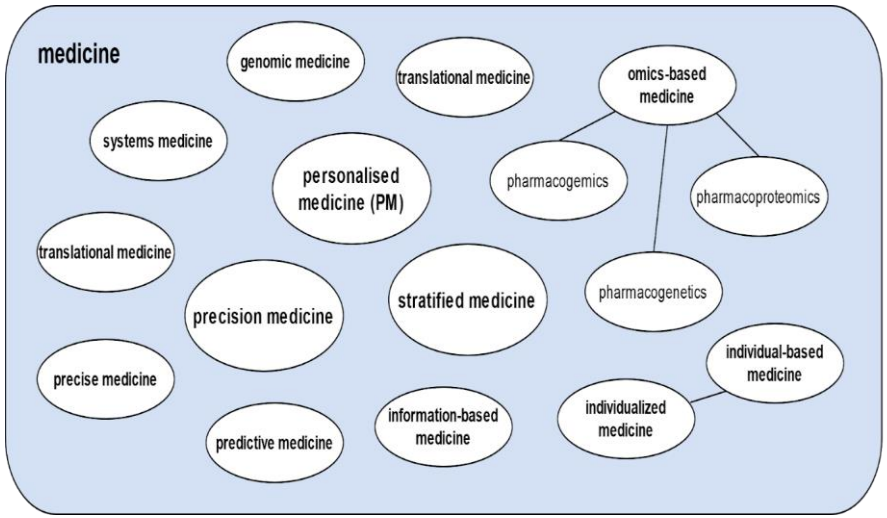
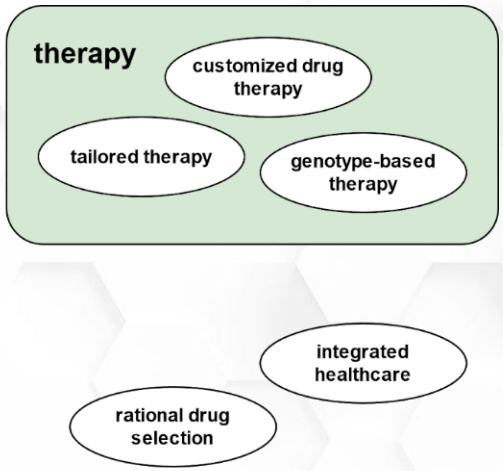
Definition of Personalized Medicine

The many faces of Personalised Medicine



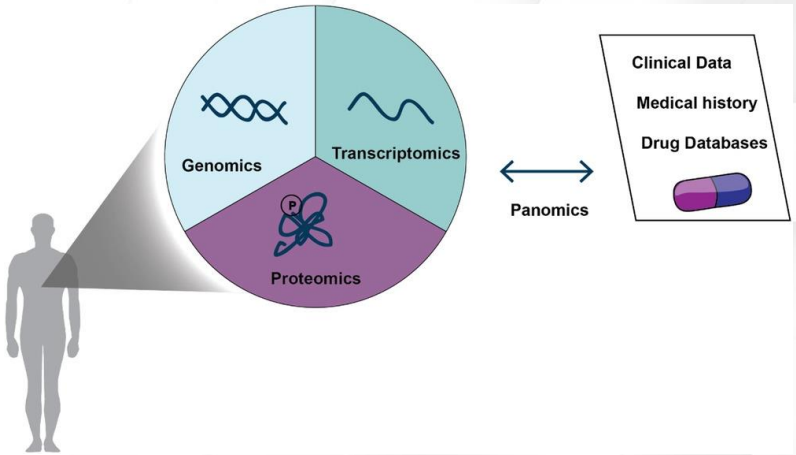


Bodiroga-Vokobrat, N., Rukavina, D., Pavelić, K., & Sander, G. (2019). *Personalized medicine in healthcare systems* (1st ed., p. 411). Springer International Publishing.

Personalised Medicine in Europe

Personalized medicine

- refers to a medical model using characterization of individuals' phenotypes and genotypes (e.g. molecular profiling, medical imaging, lifestyle data)
- aim is to tailor the right therapeutic strategy for the right person at the right time



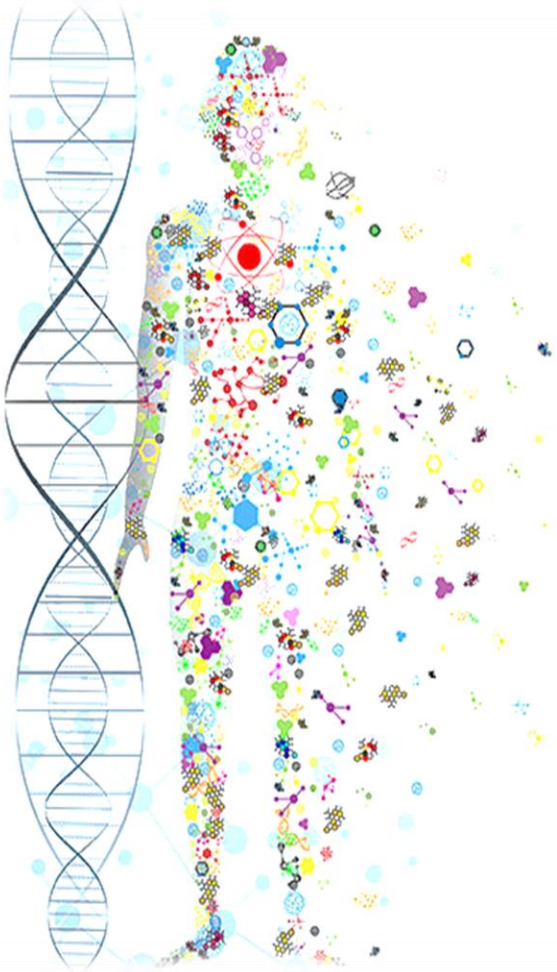
- identification of risk factors, predisposition to disease, timely and targeted prevention
- relates to the concept of patient-centred care, healthcare systems need to better respond to patient needs

Precision Medicine in China

Precision Medicine

- refers to a medical model
- combines modern technological tools and traditional medical techniques
- understanding of human mechanisms and diseases
- though efficient, safe, and sustainable approach to prevention and treatment
- tailored to individual patients
- based on their genetic content and lifestyle
- linked to the concept of precision surgery (2006) and traditional Chinese medicine

  → treating the same disease in different ways



The terms *Precision Medicine* and *Personalised Medicine* (PM) are therefore *interchangeable*

European strategy in PM

Key challenges and objectives:

- better understand disease mechanisms
- harmonised methods for the handling and storage of tissue and data
- biomarker development
- regulatory clarity regarding the qualification and validation of biomarkers as well as the approval of diagnostic tests
- faster uptake of validated 'omics' technologies in clinical practice
- better training of healthcare professionals in the application of personalised medicines

Chinese strategy in PM

Key challenges and objectives:

- creation of PM sector through China Precision Medicine Initiative (PMI) - 15-year project to establish China as a world leader in the field
- fostering scientific research to understand genetics and biological make-up of people
- development of cutting-edge data collection and analysis tools
- building of powerful high-performance computing clusters

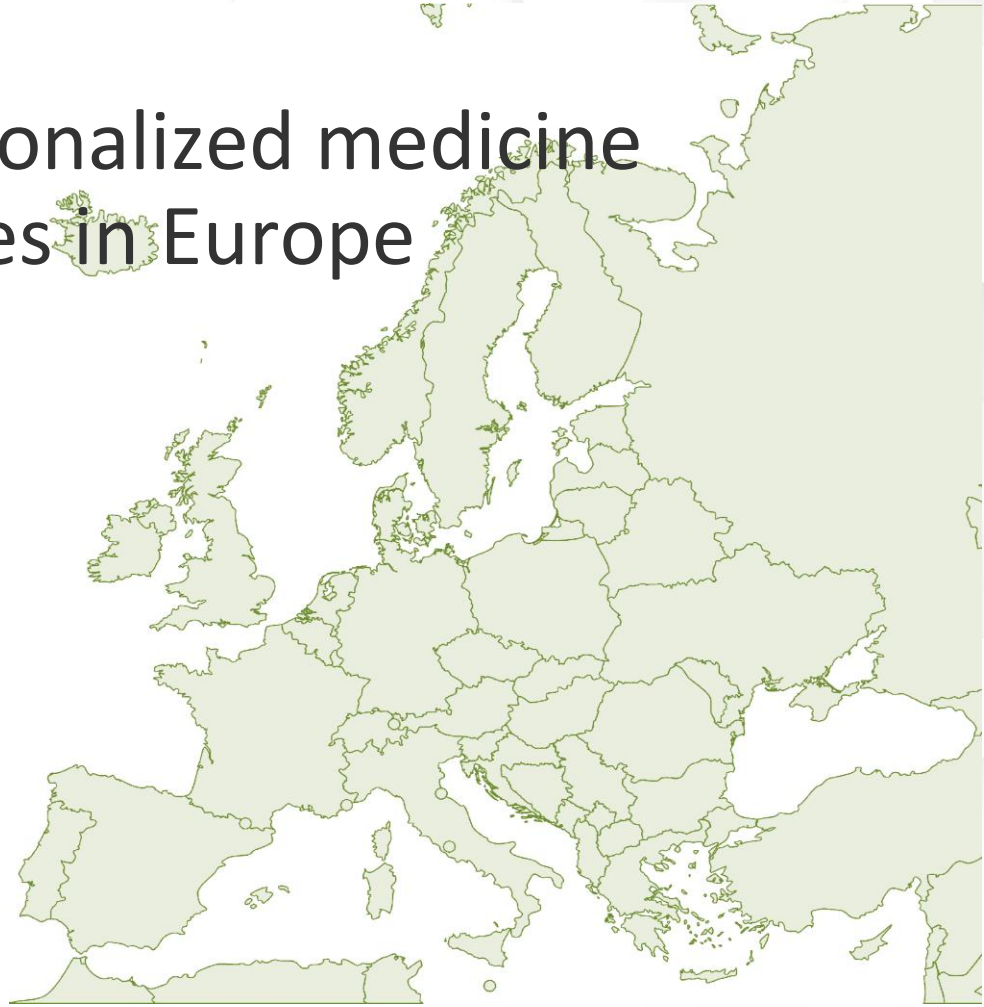
Comparison of PM in Europe and China

Fields of interests and vision

- Data and technology
- Inter-sectoral synergies
- Healthcare and systems reform
- Education and literacy
- **Next generation medicine**

- New clinical life sciences technologies
- Large scale cohort studies
- Big Data platforms and infrastructure
- Sustainable healthcare system
- **Health system reform**

Part II: Mapping of personalized medicine policies and programmes in Europe



Mapping methods

Definitions:

- A **policy measure** embodies an institution's political vision and direction using a set of rules and guidelines that specify how a particular objective is being met long-term.
- A **programme** is an explicit outline of activities and events following a precise timeframe with rigid budget constraints.
- An **action plan** is a detailed proposal defining key priorities and objectives with the goal to improve regulations, finding schemes and knowledge about a certain topic.

Mapping methods and results

Desk Research

- Institutional repositories
- Grey literature research
- Consultation of Horizon 2020 National Contact Points regarding health

D1.1 Results	Policy – 27 EU 20 EU MS
	Program – 7 EU 5 EU MS
	Action Plan – 4 EU 2 EU MS

Introduction of PM in Europe

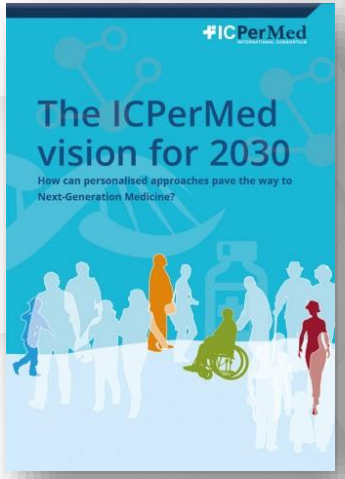
2008
«towards more personalized medicines»

2013
«use of '-omics' technologies in the development of PM»

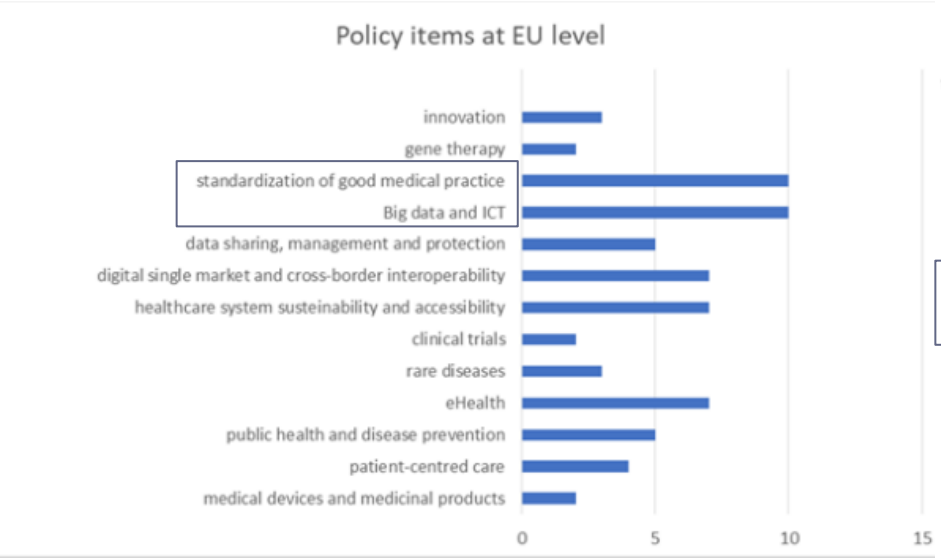
2015
«Council conclusions on personalised medicine for patients»

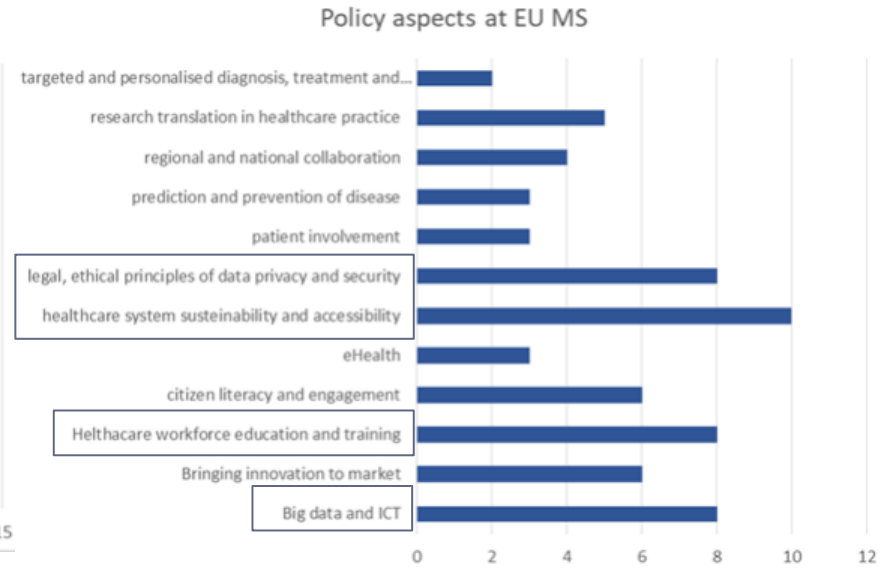
2015
«Shaping Europe's vision for Personalised Medicine»

2016
ICPerMed was launched



Policies at EU and EU Member States level



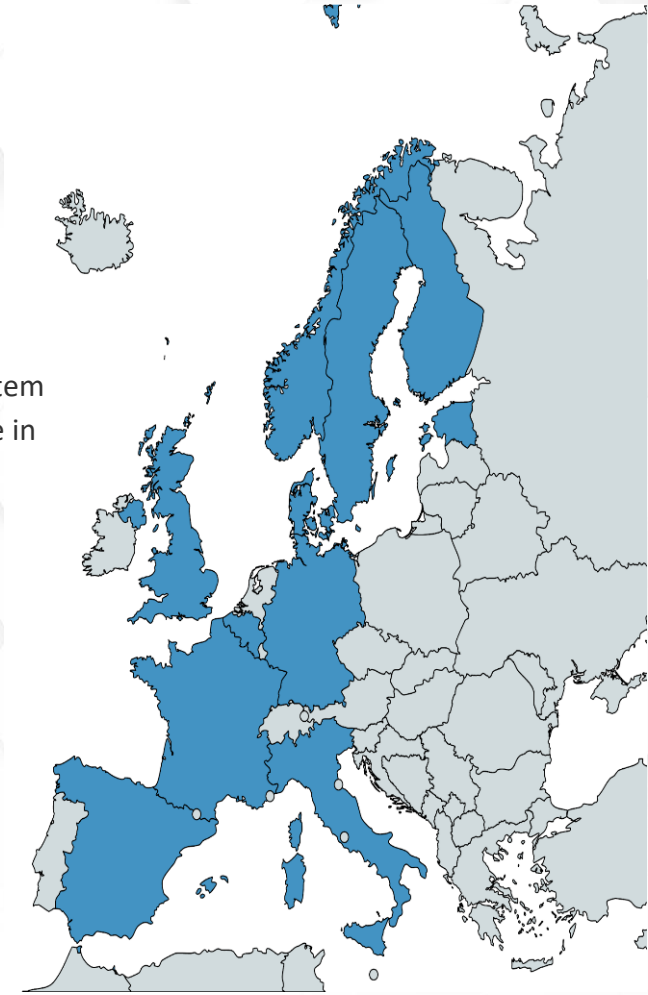


PM Policy at EU level

- Directive 98/79/EC of the European Parliament and of the Council of 27 October 1998 on in vitro diagnostic medical devices
- Regulation (EC) No 141/2000 of the European Parliament and of the Council of 16 December 1999 on orphan medicinal products
- Directive 2001/20/EC of the European Parliament and of the Council of 4 April 2001 on the approximation of the laws, regulations and administrative provisions of the Member States relating to the implementation of good clinical practice in the conduct of clinical trials on medicinal products for human use
- Directive 2001/83/EC of the European Parliament and of the Council of 6 November 2001 on the Community code relating to medicinal products for human use
- Regulation (EC) No 726/2004 of the European Parliament and of the Council of 31 March 2004 for the authorisation and supervision of medicinal products for human and veterinary use
- Article 168 of the Treaty on the Functioning of the European Union (2008)
- Regulation (EC) No 1394/2007 of the European Parliament and of the Council of 13 November 2007 on advanced therapy medicinal products
- Commission Recommendation of 2 July 2008 on cross-border interoperability of electronic health record systems (notified under document number C (2008) 3282)
- Council recommendation of 8 June 2009 on an action in the field of rare diseases 2009/C 151/02
- Council conclusions on innovation in the medical device sector 2011/C 202/03
- Directive 2011/24/EU on the application of patients' rights in cross-border healthcare
- Clinical trials - Regulation EU No 536/2014
- Council conclusions on innovation for the benefit of patients (2014/C 438/06)
- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)
- Council Conclusions on the EPC- Commission Joint Report on health care and long-term care in the EU, 2016
- Council conclusions on shaping Europe's digital future 2020/C 202 I/01
- Commission Recommendation (EU) 2019/243 of 6 February 2019 on a European Electronic Health Record exchange format

PM National Policy and Programs at EU MS level

- 2013 Italian National Plan for Public Health Genomics 2013
- 2013 German Personalised Medicine – Action Plan 2013
- 2014 - 2020 Malta National Health Systems Strategy
- 2015 NHS England Personalised Medicine Strategy
- 2015 Finland´s Genome Strategy
- 2015 - 2020 Research, Development and Innovation Strategy for the Estonian Health System
- 2016 Roadbook for the implementation of next-generation sequencing in clinical practice in oncology and hemato-oncology in Belgium
- 2016 Scotlands' National Clinical Strategy
- 2016 - 2018 Finland: Health Sector Growth Strategy for R&I Activities Roadmap
- 2017 Italian National Plan for Innovation of the Health System based on -omics sciences
- 2017 - 2020 Denmark National Strategy for Personalised Medicine
- French National Health Strategy 2018-2022
- 2019 Sweden's National Life Science Strategy
- 2020 GENOME UK national genomic healthcare strategy
- 2020 Estonian eHealth Strategic Development Plan
- National Research Priorities for Luxembourg in 2020 and beyond
- 2020 The Finnish National eHealth and eSocial Strategy
- 2020 Spanish Strategy for Personalised Medicine



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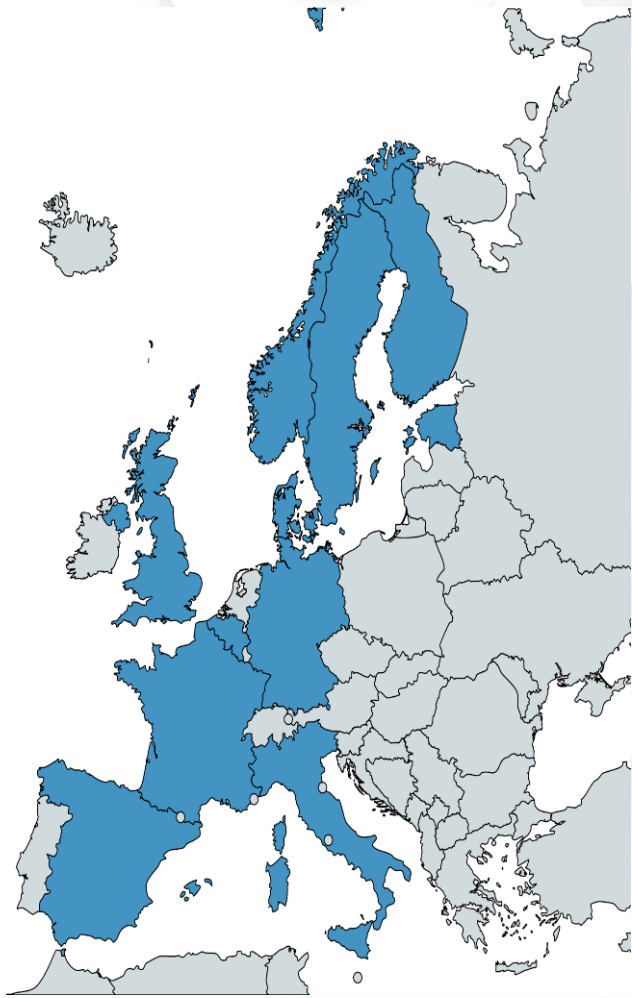
PM National Policy and Programs at EU MS level ...Common Focus:

- Patient-tailored treatment
- Targeted prevention
- Public understanding of PM
- Education and training of healthcare workforce on PM
- Patient empowerment
- Big-Data and ICT-Solutions
- Healthcare delivery infrastructure and data management systems
- Increased investments in PM by healthcare industry



A brief mapping of PM Projects and Inititatives

- 1+MillionGenomes Initiative
- Trans4mMED - Transformative Patient Centred Personalised Medicine Initiative
- Perso-Med
- The Genomic Medicine Sweden Initiative
- The Genome Denmark Platform
- FinnGen (Finnland)
- The French Platform for Personalised Medicine
- pMedGR (Greece)
- Austria National Coordination Platform on Personalized Medicine

ITALY

2013 Italian Plan on Public Health Genomics

Le *policy* di genomica in sanità pubblica in Italia: le sfide nella implementazione delle linee guida nel sistema sanitario nazionale
Implementation of Italian guidelines on public health genomics in Italy: a challenging policy of the NHS

Stefania Boccia,[1] Antonio Federici,[2] Marco Colotto,[1] Paolo Villari[3]

[1]Sezione di igiene, Istituto di sanità pubblica, Università Cattolica del Sacro Cuore; [2]Direzione generale delle professioni sanitarie e delle risorse umane del Servizio sanitario nazionale, Ministero della salute; [3]Dipartimento di sanità pubblica e malattie infettive, Università di Roma "Sapienza"

Corrispondenza: Stefania Boccia; e-mail: stefania.boccia@ebph.it

2017 Italian National Plan for Innovation of the Health System based on Omics Sciences

COMMENTARY Epidemiology Biostatistics and Public Health - 2017, Volume 14, Number 4

Implementation of genomic policies in Italy: the new National Plan for innovation of the Health System based on omics sciences

*Stefania Boccia [1] *, Antonio Federici [2], Roberta Siliquini [3], Giovanna Elisa Calabrò [1], Walter Ricciardi [4,5] on behalf of the Expert table of the Ministry of Health^*

The main objectives of the national plan for innovation are:

1. to transfer genomic knowledge into the practice of health services, in a patient-centric approach;
2. to increase the effectiveness of prevention, diagnosis and treatment of diseases at a higher burden, taking into account individual differences in genetic heritage, lifestyles and the environment, and providing professionals with the resources needed to customize interventions;
3. to promote the cultural, scientific and technological innovation of the healthcare system.

Federal Ministry
of Education
and Research

2013

Personalised Medicine – Action Plan

A New Approach in Research and Health Care

Short-term achievements (1-5 years)

- Faster and more precise diagnosis on the basis of validated biomarkers
- Improved treatments thanks to closer linking of diagnosis with therapy and the integration of data into research and medical practice
- Increased investment in personalised medicine by the health care industry
- Better public understanding of personalised medicine

Long-term achievements (6-10 years)

- Reduction of side effects thanks to targeted drugs
- Avoidance of ineffective treatments
- Accelerated market entry for personalised medicine products and services
- Establishment of more patient-tailored medicine

Part II: Mapping of PM policies and programmes in China

Mapping methods and results in WP1


Desk Research


Field-trip


Interview

D1.1 Results	Policy – 12
	Program - 17
	Action Plan - 12

Introduction of PM in China

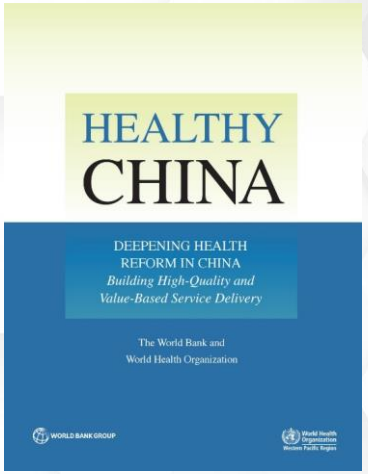
1970s
Introduction of the concept of personalized medicine

2011
Toward «precision medicine»

2015
«Precision medicine»

2016
White Paper on «Precision medicine» in China

Healthy China 2030 Plan Outline



Policies related to PM: National Laws

- 2020 - Biosecurity Law of the People's Republic of China [Not Yet Effective]
- 2020 - Data Security Measures [Management Consultation Draft] – Cyberspace Administration of China
- 2018 - National Health and Medical Big Data Standards, Safety and Service Management Measures [Trial]
- 2018 - Management Measures on National Health and Medical Big Data Standards, Security and Service [Trial]
- 2017 - Cyber Security Law of the People's Republic of China – Cyberspace Administration of China
- 2014 - Management Measures on Population Health Information [Trial]

Policies related to PM: Outlines and Guidance

- 2015 - Outline of Action to Promote the Development of Big Data
- 2016 - Outline of National Innovation-driven Development Strategy
- 2015 - Guiding Opinions on Actively Promoting the "Internet+" Action
- 2016 - Guiding Opinions on Promoting the Healthy Development of the Pharmaceutical Industry
- 2016 - Guiding Opinions on Promoting and Regulating the Development of Health and Medical Big Data Applications
- 2016 - Notice regarding the publication of the 2016 national project application guidelines for key special projects on precision medicine research in the National Key R&D Programme
- 2018 - Opinions on Promoting the Development of "Internet + Medical Health"

PM Programs

The 13th Five-Year Plan for National Economic and Social Development of the People's Republic of China – MOST, 2016

- By 2030, 60 Billion RMB investment
- Research platform and core key technology
- Drugs, vaccines, devices and equipment
- Guidelines, clinical pathways and interventions
- Health Technology and Biotechnology Innovation, Biological Industry Development, Health and healthcare Informatization
- Health system reform

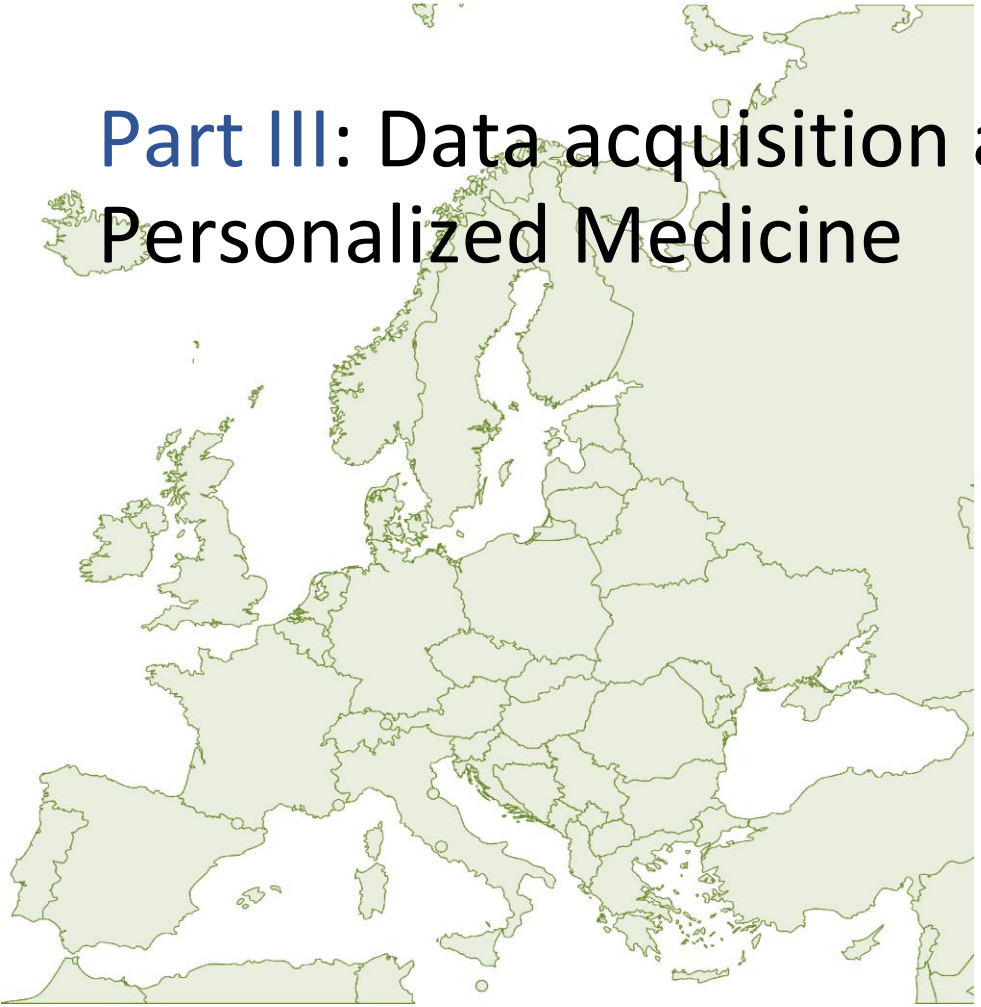
PM Action Plans

- 2014-Notice of CFDA on the definition of 3 product categories including genetic analysers
- 2014-Notice on Strengthening the Management of Clinical Use of Gene Sequencing Related Products and Technology
- 2015-Notice of the National Development and Reform Commission on the implementation of major engineering packages for emerging industries
- 2015-Tumour personalised treatment testing technology guide [Trial]
- 2016-Notice of standardising and orderly carrying out prenatal screening and diagnosis of free DNA of pregnant women's peripheral blood foetus

PM Action Plans

- N/A-Technical Guideline for Gene Detection Technology of Drug Metabolizing Enzymes and Drug Action Targets [Trial]
- 2017-Catalogue of key products and services for strategic emerging industries
- 2017-Infectious Disease-Related Personalised Medical Molecular Detection Technology Guide
- 2017-Technical Specifications of Microarray Gene Chips for Personalized Medical Testing
- 2018-Notice on further reform and improvement of the examination and approval work of medical institutions and physicians
- 2018-Guiding Principles for Clinical Application of New Antitumour Drugs, 2018 Edition

Part III: Data acquisition and sharing in Personalized Medicine



Important European policies regarding medical data

Specific policies:

Complementary policies on data procedures

Gain of importance of PM principles

Digital Health — 2008

Commission recommendation on **cross-border interoperability** of **electronic health record systems**

Digital Health — 2011

Directive 2011/24/EU of the European Parliament and of the Council on the application of **patients' rights in cross-border healthcare**

PM & Digital Health — 2018

Commission communication on enabling the **digital transformation** of **health and care** in the **Digital Single Market**; empowering citizens and **building a healthier society**

2016

Regulation (EU) 2016/679 of the European Parliament and of the Council on the **protection of natural persons** with regard to the **processing of personal data** and on the **free movement of such data** (GDPR)

Major focus on **PM** and **personalised care**, offering better data to advanced research and the development of digital tools for **citizen empowerment**, creation of **PM data standards** across all member states.

Important Chinese policies regarding medical data

Specific policies:

Electronic Health Records 2014

Management measures on **population health information** (Trial) - National Health Commission of the PRC

Big data & governance 2015

Outline of action to **promote** the **development of big data** - State Council of the PRC

Guidelines for Big Data in Health 2018

National health and **medical big data standards**, **safety and service management measures** (Trial) - National Health Commission of the PRC

Complementary policies on data procedures

2019

Cyber Security Law of the People's Republic of China - Cyberspace Administration of China

2020

Data Security Management Measures (Consultation Draft) - Cyberspace Administration of China

Defines obligations regarding the **generation**, **collection**, **storage**, **use**, **transmission**, **sharing**, **exchange** and **destruction** of **Big Data**. Healthcare-related Big Data must be stored in China.
Where such data must be transferred abroad for business reasons, a security assessment must be carried out in accordance with the relevant laws and regulations.

Part IV: Research funding programmes on Personalized Medicine in Europe and China

Research funding Programmes

D1.2
Map of major funding agencies and stakeholder in Europe and China

Mapping objectives: Funding schemes providing financial support to the realization of PM related projects

European framework programme

- **7-year period (Horizon Europe 2021-2027)**
- **work programme (2 years)**
- **definition of major goals + detailed funding schemes**

Chinese Five-Year Plans

- **5-year period (2021-2025)**
- **sector specific sub-plans (special plans)**
- **regional sub-plans**
- **policy related, detailed economic development guidelines**

Health related research in Horizon Europe

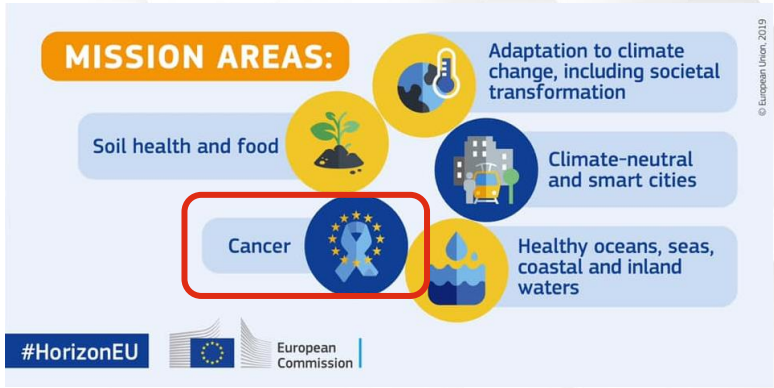
Horizon Europe Framework Programme for Research & Innovation (2021-2027) — EUR 95.5 billion

Global Challenges and Industrial Competitiveness (2021-2027)

Global Challenges: Cluster 1 Health — EUR 7.5 billion

Work Programme 2021-2022 (Destinations, Topics, Calls) — EUR 1.9 billion

Horizon Europe missions



Funding schemes and programmes in Europe

Public-Public Partnerships in EU Research (P2P)

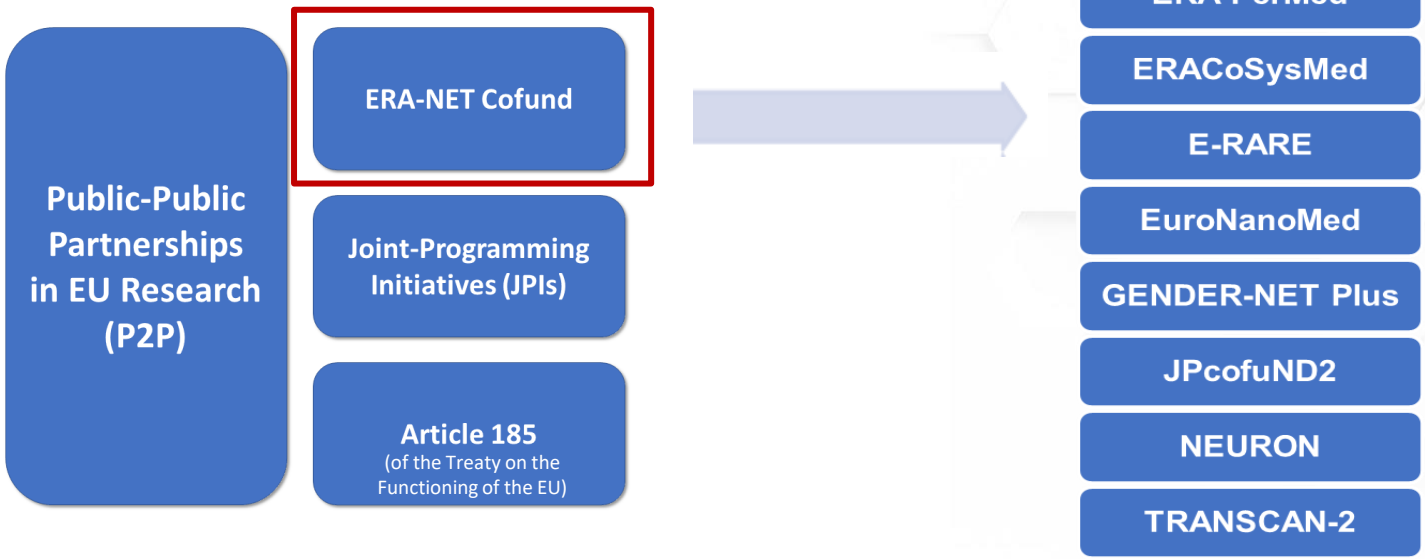
- **ERA-NET Cofund**
- **Joint-Programming Initiatives (JPIs)**
- **Article 185** (of the Treaty on the Functioning of the EU)

- P2P allow EU countries to draw up joint research programmes which the EU may participate in

- Aiming to:
  - pool and coordinate national research efforts
  - make better use of Europe's public research and development resources
  - tackle common European challenges more effectively

ERA-NETs

- Funding schemes financed by EC in various research fields
- Create a European Research Area (ERA) in which research is conducted and funded across countries, allowing research groups to jointly work on specific problems, exchange ideas, and benefit from cross border expertise

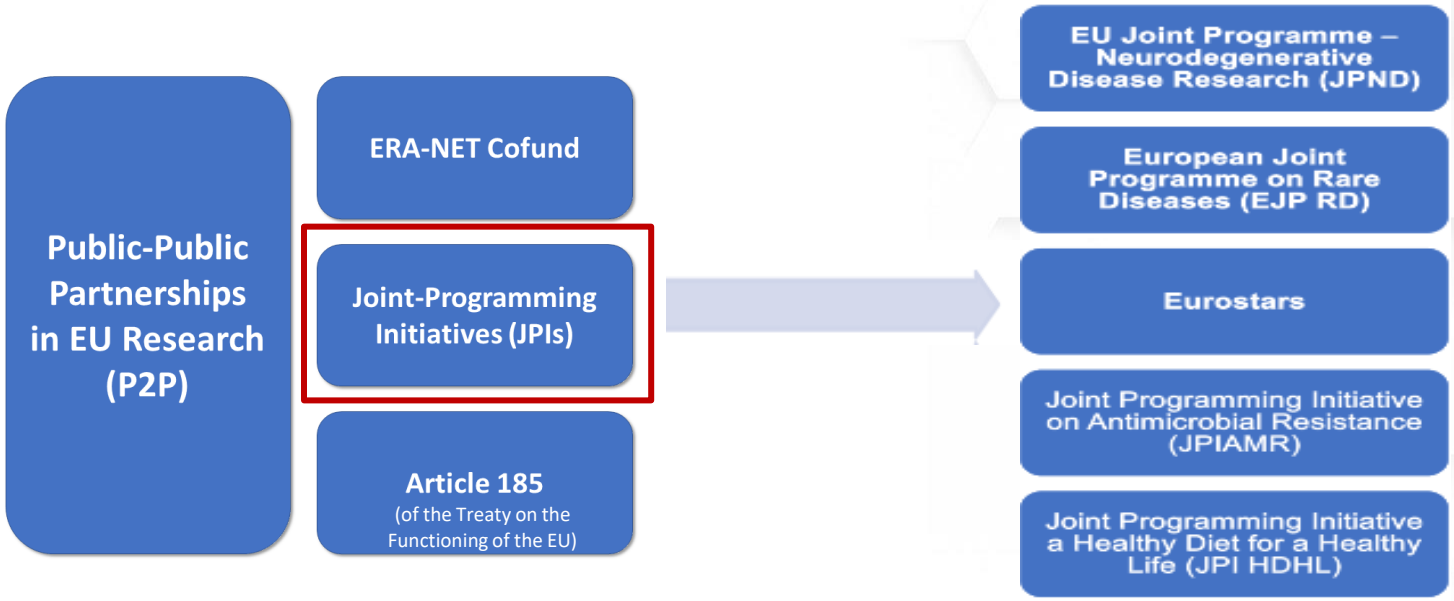


ERA-NET Cofunds related to Personalised Medicine

European Joint Programming Initiatives (JPI)

- Structured and strategic process whereby EU Member States agree, on a voluntary basis and in a partnership approach, on common visions, the so-called Strategic Research and Innovation Agendas (SRIA), to address major societal challenges

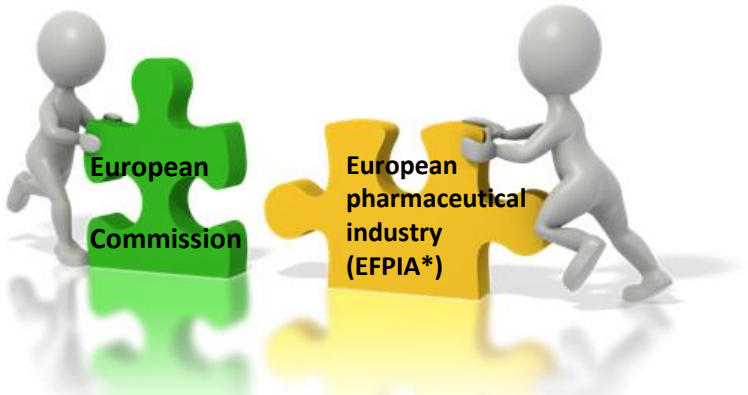
- Develop and implement based on the common agenda specific Joint Programming Initiatives (JPI) including the launch of joint calls, fast track activities, knowledge hubs and task forces



PM-related TFEU Article 185 initiative

Public-Public Partnerships in EU Research (P2P)

- ERA-NET Cofund
- Joint-Programming Initiatives (JPIs)
- **Article 185** (of the Treaty on the Functioning of the EU)

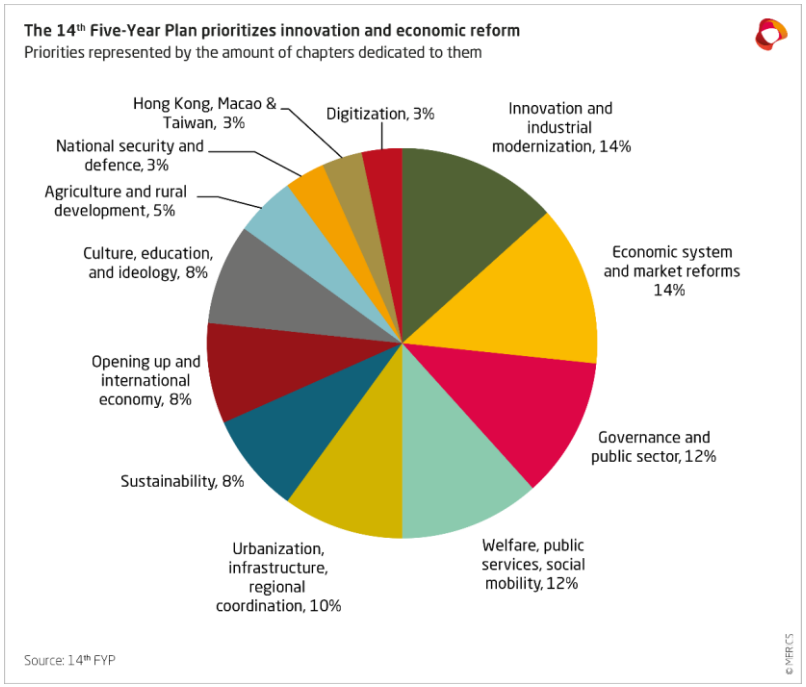


Biggest public-private partnership (PPP) in life sciences

Innovative Medicines Initiative (IMI)

*EFPIA - European Federation of Pharmaceutical Industries and Associations, the representative of European pharmaceutical industry

14th 5-Year Plan (2021-2025)



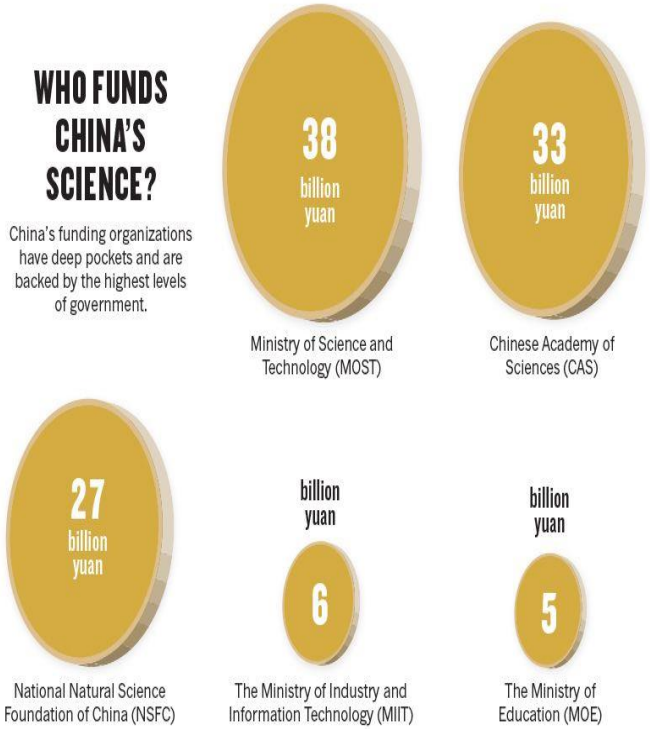
Key projects

2021-2025: 19 projects

- 1: Technological frontiers
- 2: Science and technology infrastructure
- 3: Manufacturing competitiveness
- 4: Infrastructure
- 5: Modern energy system
- 6: National water systems
- 7: Digital economy
- 8: Digital applications

https://merics.org/de/kurzanalyse/chinas-14th-five-year-plan-strengthening-domestic-base-become-superpower

Funding in China



Identified common objectives

- **Upscaling** of **health systems** by reducing ineffectiveness and overtreatment (PM approach)
- **Overcoming fractionation** in domestic market (multi-tier health systems, national states/provinces)
- **Standardization of data** (omics-research and electronic health records) and interoperability between different stakeholders and across borders
- **Data protection** (GDPR, Cyber Security Law) and **Data sharing** to develop new services and applications
- **Patients/citizens' engagement** and public understanding of PM
- **Healthcare workforce literacy** and training

Synergies and gains from a closer cooperation

- Health challenges must be tackled globally in a concerted manner
- Alignment of research efforts leads to more efficient research, reduction of redundancies
- Big economic potential, important stakeholders/global leaders (e.g. BGI in whole genome sequencing) extend their reach and value chains to new markets
- Sino-European collaboration on standardization in PM will benefit the whole field
- Further intensification of common research initiatives in science and technology

Synergies and gains from a closer cooperation

A clear identification of the facilitators for cooperation

- Funding of bilateral activities and projects
- Frameworks for exchange of ideas, experts, knowledge
- Need for policymaker to ease the interoperability of standards and data

Need to overcome the barriers

- Different political systems
- Public understanding of the value of PM
- Lack of consensus in interpretation and use of guidelines for PM

Conclusion

- Personalised Medicine has the potential to disrupt the medical field bringing major improvements for the benefit of public health.
- PM affects both citizens and patients, their families and communities, as well as all levels of the entire healthcare system.
- The development of PM requires concise action across universities, industries and national governments and urges for synchronous development on a global scale.

Conclusion

Aligning European and Chinese efforts, finding common ground across cultural, social and language barriers, can enhance public health efforts in the application of personalised medicine strategies internationally.

Thank you for your attention!

谢谢

SINO-EU PerMed

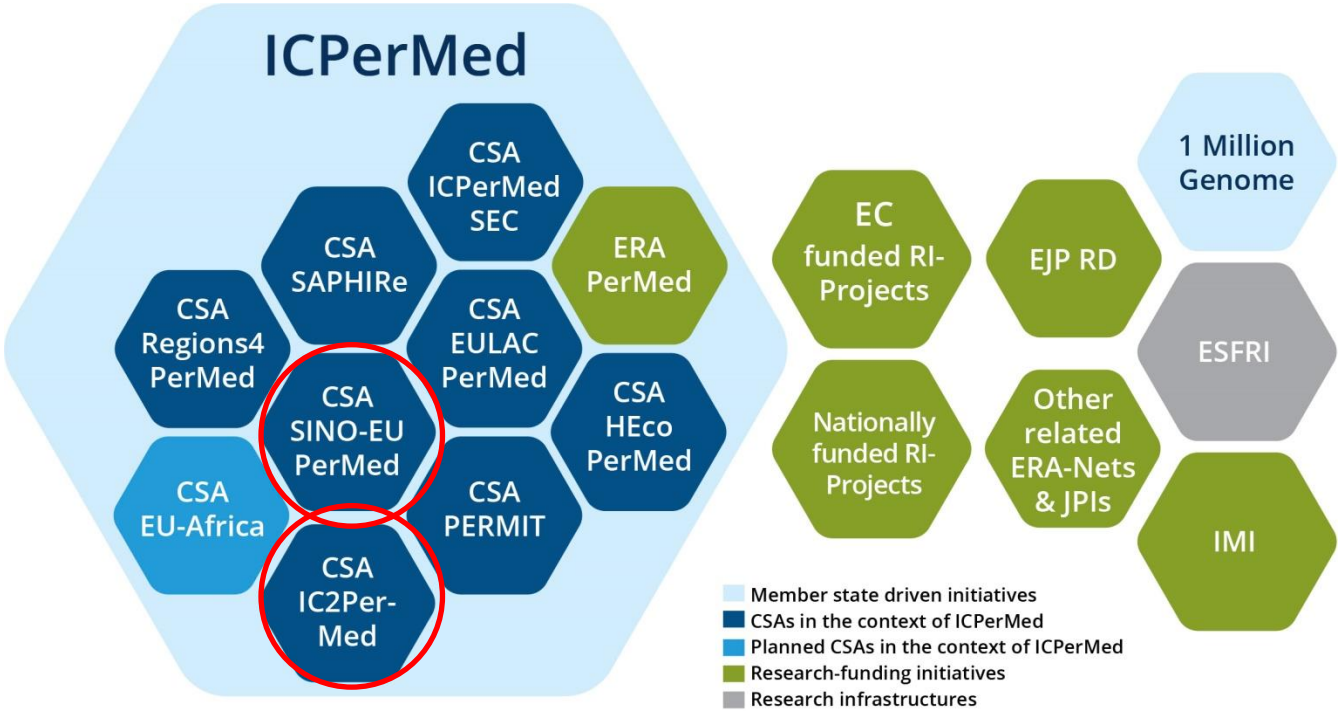
Cooperation between China and Europe in Personalised Medicine

Widening **Sino-EU** policy and research cooperation in **Per**sonalised **Med**icine

SINO-EU PerMed

Cooperation between China and Europe in Personalised Medicine

ICPerMed Family



SINO-EU PerMed

Cooperation between China and Europe in Personalised Medicine

Widening **Sino-EU** policy and research cooperation in **Per**sonalised **Med**icine

German Aerospace Center, Project Management Agency (DLR-PT)

DLR-PT

Fondazione Toscana Life Sciences (TLS) - Italy

TLS TOSCANA LIFE SCIENCES

Jiangsu Center of International Technology Transfer (JITTC) - China

江苏省跨国技术转移中心
Jiangsu Center of International Technology Transfer

Innovation Fund Denmark (IFD)

Innovation Fund Denmark

Guangzhou Institutes of Biomedicine and Health CAS (GIBH-CAS) - China

Guangzhou Institutes of Biomedicine and Health, Chinese Academy of Sciences

Health Research Board (HRB) - Ireland

HRB Health Research Board

SINO-EU PerMed has been granted for funding through the current EU Framework Programme for Research and Innovation ‘Horizon 2020’ under grant agreement no 874556

SINO-EU PerMed

Cooperation between China and Europe in Personalised Medicine

Kickoff Meeting

- Rome, 18-20 February 2020
- Hybrid Event EU and China
- Exchange with IC2PerMed back-to-back activities

SINO-EU PerMed

Cooperation between China and Europe in Personalised Medicine

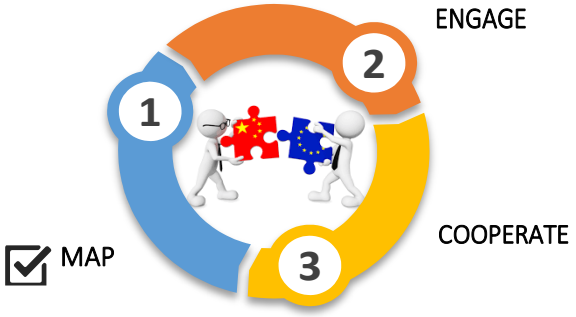
Objectives

- To gain knowledge and **understanding of the scientific and policy landscape** and its main players within PerMed in China.
- To engage relevant PerMed stakeholders in China and Europe and discuss the main **needs and barriers for PerMed research and policy implementation**.
- To involve **stakeholders in China and in Europe** from various provinces and countries, covering existing excellence and diversity in both regions and reducing existing gaps.
- To **build links** between Chinese and European organisations and research centres with interests in PerMed R&I and policy and to foster their **participation in ICPerMed** and the ICPerMed Action Plan.
- Invite Chinese stakeholders to the **ICPerMed challenge groups, workshops, conferences** and other events and initiatives.

SINO-EU PerMed

Cooperation between China and Europe in Personalised Medicine

Major Activities



Mapping

Science and technological Mapping of EU-China Cooperation in PerMed

- S&T Mapping and Database, ✓
- SWOT Analyses, ✓
- Stakeholder event
- Policy Paper on Barriers and Needs

Engaging

Science & Policy Dialogue between China and Europe / ICPerMed

- Involve Chinese funding agencies and policy-making institutions with ICPerMed
- Participation of Chinese representatives in ICPerMed events
- *(Delegation trips)*

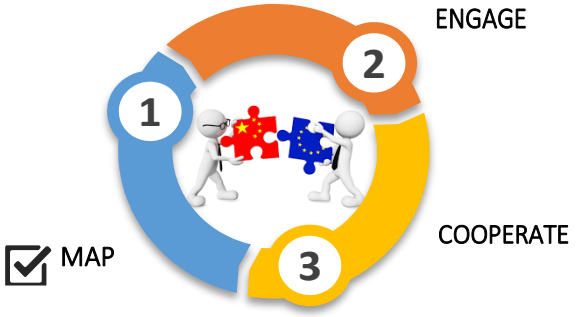
Cooperating

Paving the Science &Technology way to Europe – China collaboration in PerMed

- ✓
- S&T and ELSA task forces
- S&T Workshops
- ELSA Workshop
- Policy Paper on ELSA

SINO-EU PerMed
Cooperation between China and Europe in Personalised Medicine

Major Activities



Mapping

Science and technological Mapping of EU-China Cooperation in PerMed

- S&T Mapping and Database, ✓
- SWOT Analyses, ✓
- Stakeholder event
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Engaging

Science & Policy Dialogue between China and Europe / ICPerMed

- Involve Chinese funding agencies and policy-making institutions with ICPerMed
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Cooperating

Paving the Science &Technology way to Europe – China collaboration in PerMed

- ✓ S&T and ELSA task forces
- S&T Workshops
- ELSA Workshop
- Policy Paper on ELSA

SINO-EU PerMed
Cooperation between China and Europe in Personalised Medicine

S&T Expert Task Force

Kick-off Meeting Expert Task Force 25 November 2021

Members

Charitè Berlin
Silreal GmbH
Università degli Studi di Siena
Centre for Integrative Medicine Tuscany
Natural and Medical Sciences Institute
Danish Innovation Center in Shanghai
HKU-Shenzhen Hospital
Bio4Business/Nanjing Tech University
Shanghai Institute of Materia Medica
Homeopathic Clinic of Campo di Marte Hospital, Lucca

Workshops: Starting in 2022

Possible Topics:

- Treatments with focus on cancer and rare diseases,
- Treatments with focus on non-communicable diseases
- Traditional Chinese Medicine

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Next Events

Stakeholder Event, 16-17 February 2022

Topics:

- Personalised Medicine Landscape in Europe and China
- Mapping of Major stakeholders in Research and technology
- Traditional Chinese Medicine and Personalised Medicine
- Data regulations and the impact on PM research in Europe and China

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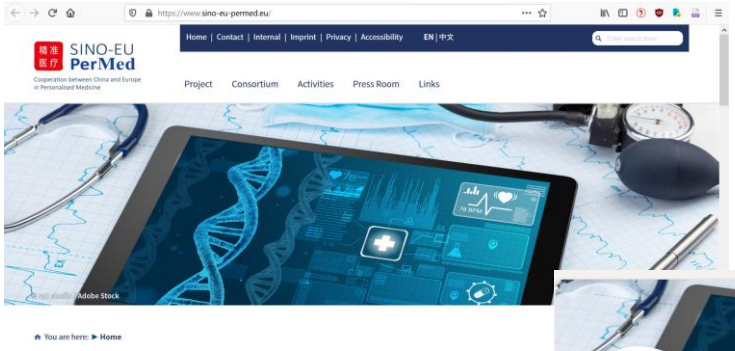
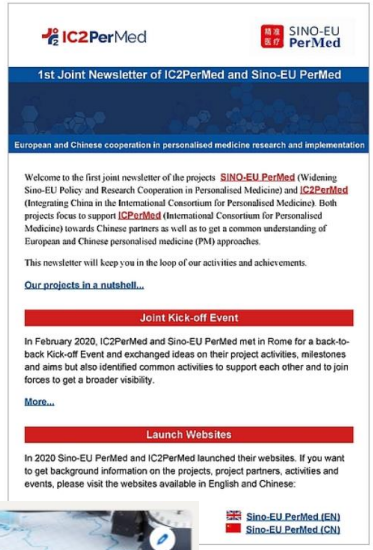
Website and Newsletter



Visit our Website
www.sino-eu-permed.eu



Sino-EU PerMed & IC2PerMed Joint Newsletter 1 (EN)

March 2021
read online
download PDF

Subscribe for our joint Sino-EU PerMed and IC2PerMed Newsletter

Connect via LinkedIn
linkedin.com/in/sino-eu-permed-project-6783b0215

Contact via Email sino-eu-permed@dlr.de

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Thank you

www.sino-eu-permed.eu

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DLR Project Management Agency |
European and International Cooperation |
Asia, Oceania

SINO-EU PerMed has been granted for funding through the current EU Framework Programme for Research and Innovation 'Horizon 2020' under grant agreement no 874556

DLR-PT

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National Key R&D Program of China (MOST)

前列腺癌的个性化药物研究
Personalised medicine for prostate cancer

Principal Investigator： Yong Xu

2021-11-04

GIBH JITTC DLR-PT

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Project Information

项目名称：前列腺癌的个性化药物研究
Project title: Personalised medicine for prostate cancer

起止年月：2020年12月 --- 2022年11月
Start and end dates: Dec, 2020 --- Jan, 2022

项目依托单位：中国科学院广州生物医药与健康研究院
Applicant: GIBH, Chinese Academy of Sciences

项目合作单位：
Collaborative partner:
German Aerospace Center, Project Management Agency (DLR-PT)
Jiangsu International Technology Transfer Center(JITTC)

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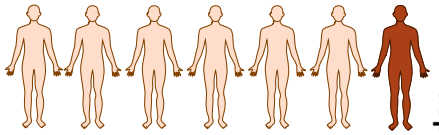
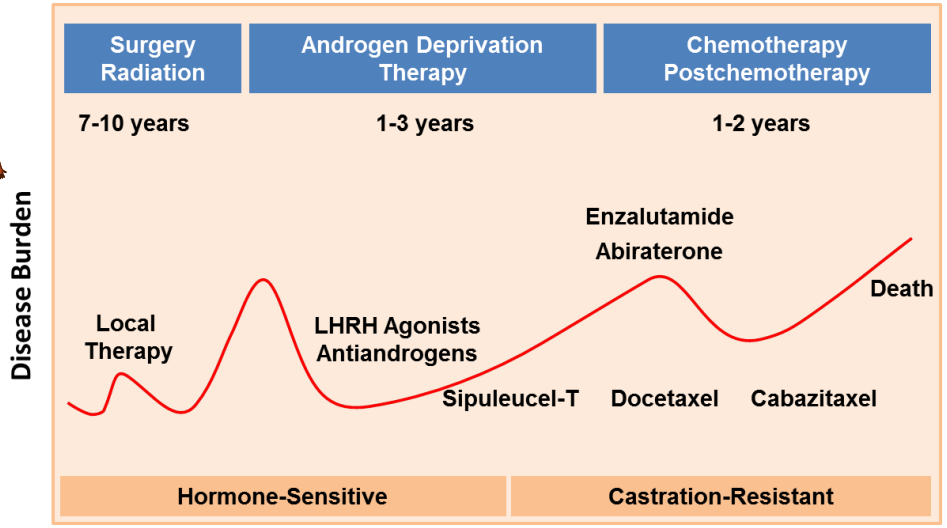
Significance

Prostate cancer progression & treatment landscape



1/7

Prostate cancer (PCa) is the most common cancer in men



LHRH agonists
AR antagonists

CRPC:
Castration-Resistant Prostate Cancer

De novo and acquired resistance to current therapies seem to be inevitable for prostate cancer patients

There is an urgent clinical need for alternative therapeutic strategies for castration-resistant prostate cancer (CRPC)

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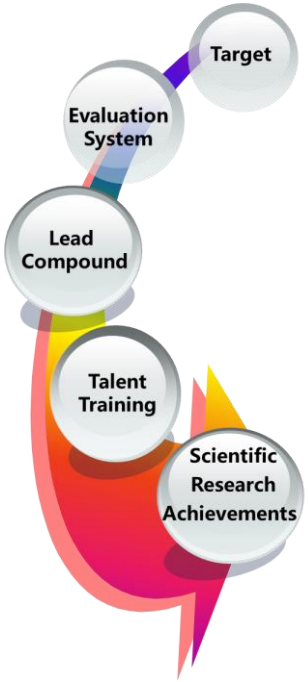
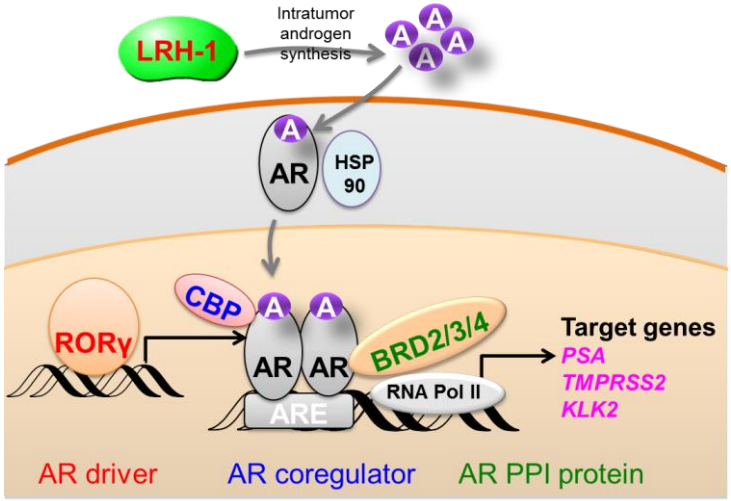
Evaluation of stability of liver microsomes





Achievements:

1. Validated 2 new targets (RORγ and CBP)
2. Developed 2 new drug candidates
3. Trained 2-4 postdoctoral fellows, 5 graduate students
4. Published 2 papers, applied for 2 patents

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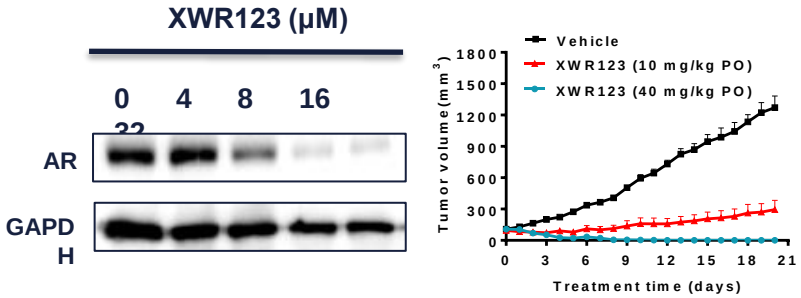
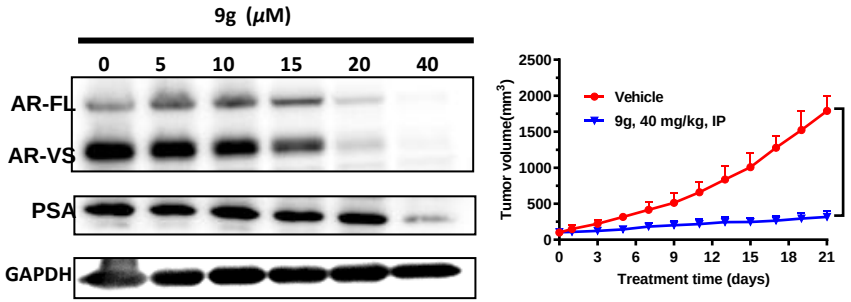
Two new drug candidates obtained



- Targeting RORγ
- XWR123 suppress androgen receptor expression and tumor growth without obvious toxicity

J. Med. Chem. 2021, 64, 8775−8797



- Targeting CBP
- 9g suppress androgen receptor expression and tumor growth without obvious toxicity *unpublished*

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Thanks!

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Mapping the tecnological and scientific Landscape

SENET-HUB
SINO-EUROPEAN HEALTH NETWORKING HUB

SINO-EU HEALTH WEEK

GIANNI D'ERRICO – FONDAZIONE TOSCANA LIFE SCIENCES

DECEMBER 3rd

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PATENT LANDSCAPE

- Part 1: Global Patent SET statistic
- Part 2: China And Europe compared statistics, co-assigned and collaboration patents
- Part 3: Preliminary data on Traditional Chinese medicine

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DEFINITIONS OF PRECISION/PERSONALIZED MEDICINE

«Personalized medicine» is a medical model using characterization of individuals' phenotypes and genotypes (e.g., molecular profiling, medical imaging and lifestyle data) for tailoring the right therapeutic strategy for the right person at the right time, and/or to determine the predisposition to disease and/or to deliver timely and targeted prevention, which makes up the 4P medicine concept (European Council Conclusion 2015/C 421/03) [27].

«Precision medicine» : Treatments targeted to the needs of individual patients on the basis of genetic, biomarker, phenotypic or psychosocial characteristics that distinguish a given patient from other patients with similar clinical presentations.

«Personalized healthcare» & precision public health» The application of clinical know-how, concepts of systems medicine and PM technologies to improve health and minimize disease

The goal of personalized medicine can be

- Diagnostics
- Design of patient-specific therapy/treatment strategy
- Forecast of success of therapy/treatment strategy

The tool of « personalized medicine » are genetic analysis, statistical analysis, patient-specific treatment, patient-specific drug.

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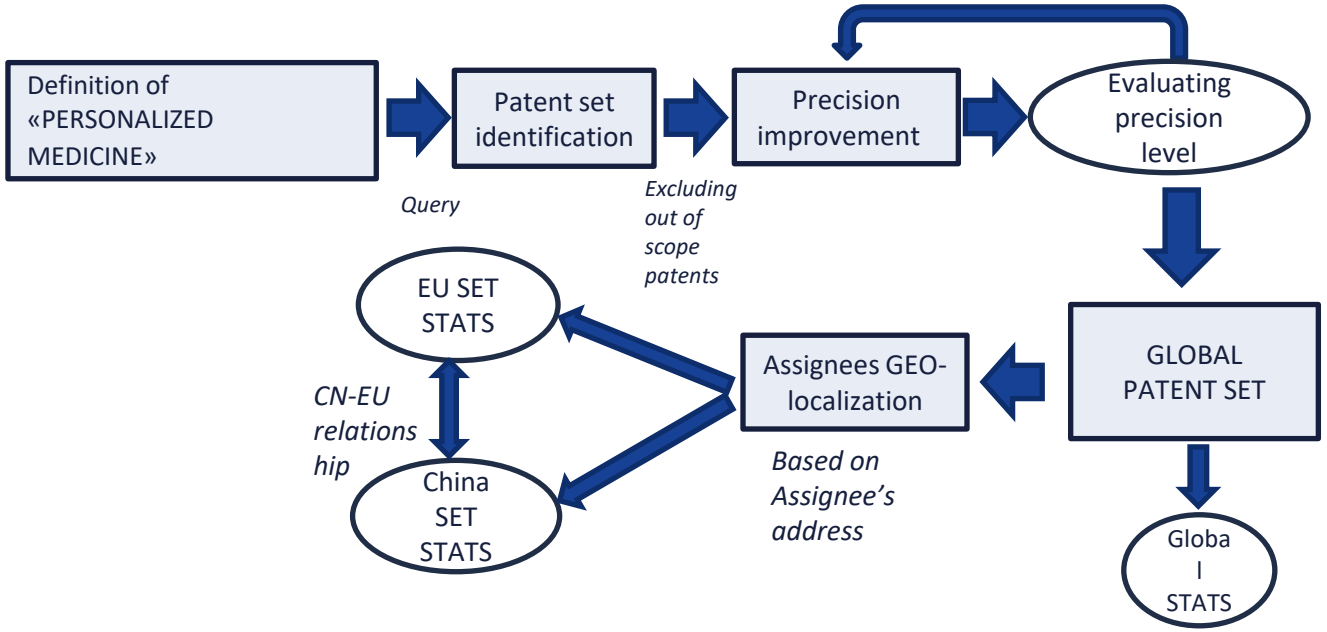
OPERATIVE FLOW



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GLOBAL PATENT SET - INFO

More inclusive patent set (focused P.M. keyword and P.M. functions)

- ~73k patents
- ~12k patent families (this set will be used for classification)
- 94,5% of **precision**
- High level of **recall**

Innovation index $I.I. = \frac{\#\ patent}{\#\ patent\ families}$

- Innovation index of global Patent Set $I.I._{Prec.Med} = 6{,}1$

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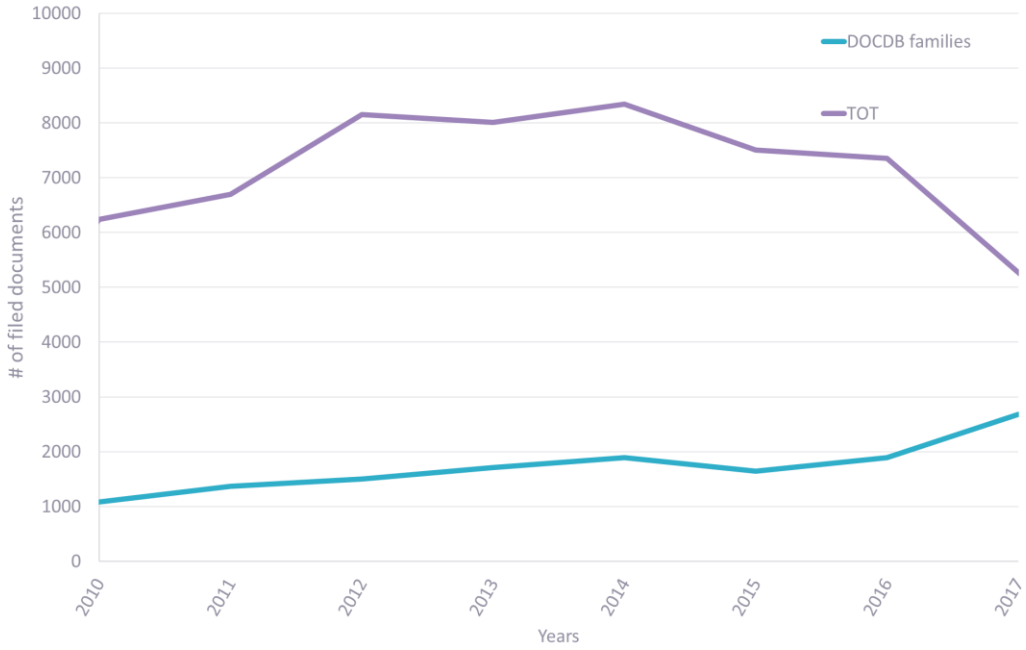
PATENT FILING Vs YEARS

patent families is more related to inventive activity

of families can show the spreading of the inventions in different countries

Years 2018-2019 should not be considered due to the secrecy times

Years 2016-2018 for the Total number can be underestimated



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GLOBAL PATENT SET - ASSIGNEES

#	Assignee	# of Families	# of Patents	I.I.	Headquarters (Country)
1	Harvard University	432	1374	3,2	Cambridge (USA)
2	Roche	411	1611	3,9	Basilea (Swisse)
3	Univ. of California	319	1054	3,3	Berkeley (USA)
4	Inserm	251	734	2,9	Paris (France)
5	Genentech	226	1250	5,5	San Francisco (USA)
6	Novartis	206	1018	4,9	Basilea (CH)
7	Philips	187	478	2,6	Amsterdam (Netherlands)
8	John Hopkins University (JHU)	186	629	3,4	Baltimora (USA)
9	Stanford University	186	582	3,1	Stanford (USA)
10	Univers. of Texas	156	510	3,3	Austin (USA)
11	CNRS	145	439	3,0	Paris (France)
12	Memorial S. Kettering Cancer Center	134	432	3,2	New York (USA)
13	Immatics Biotech.	126	514	4,1	Tübingen (Germany)
14	Medtronic	121	431	3,6	Dublino (Ireland)
15	University of Michigan	112	358	3,2	Ann Arbor (USA)

~other 2500 assignees

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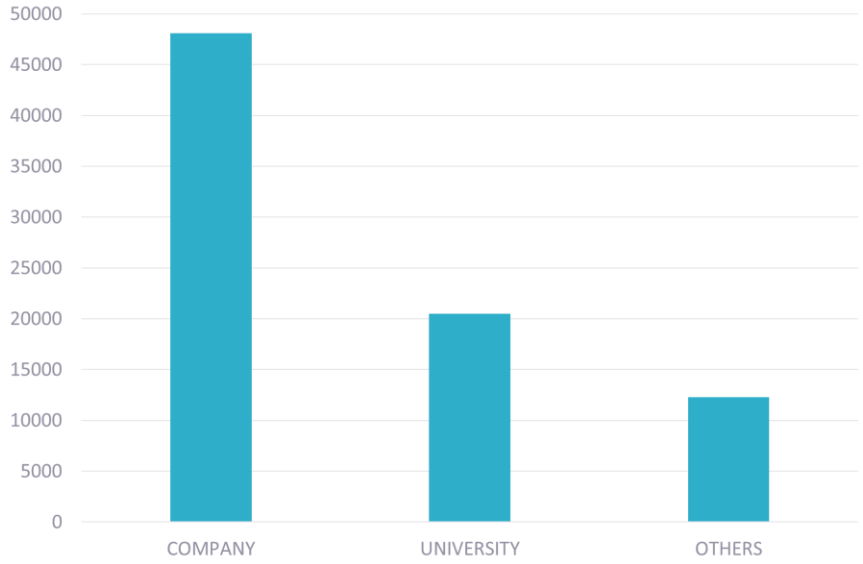
GLOBAL PATENT SET

Private companies vs Public research institutes



KIND of Assignee	#	%
COMPANY	48099	59,5%
UNIVERSITY	20474	25,3%
Others (i.e. no profit, hospital, government)	12277	15,2%

NOTE: Inventor as Assignee are not considered

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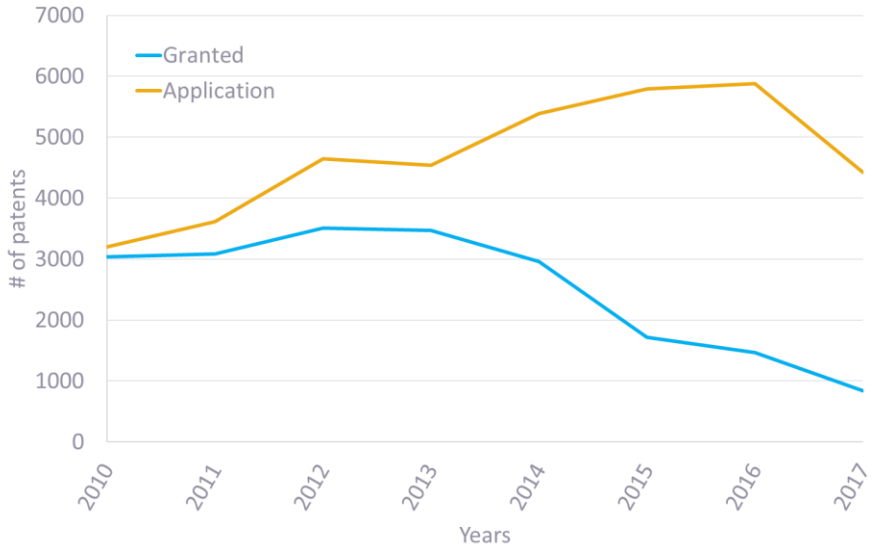
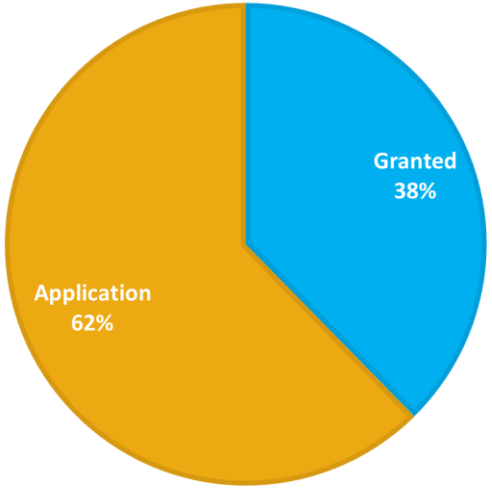
GLOBAL PATENT SET - GRANTED VS APPLICATION





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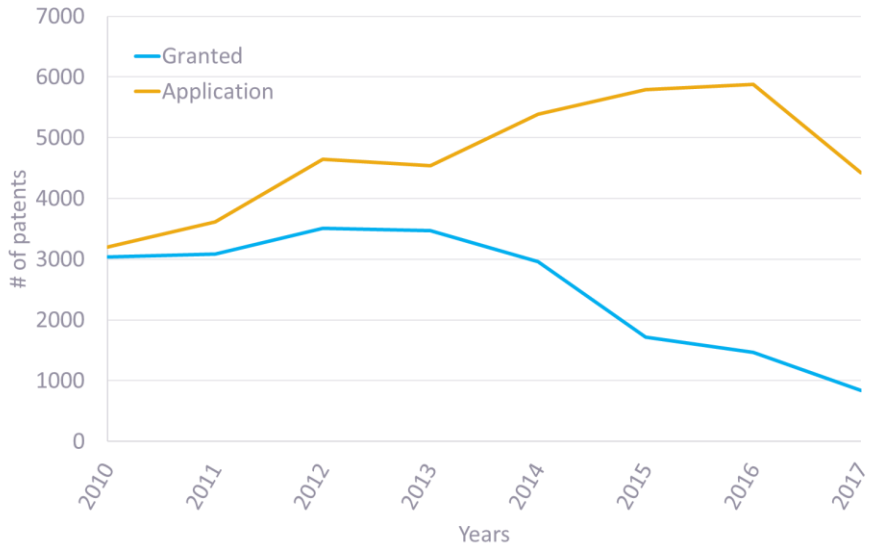
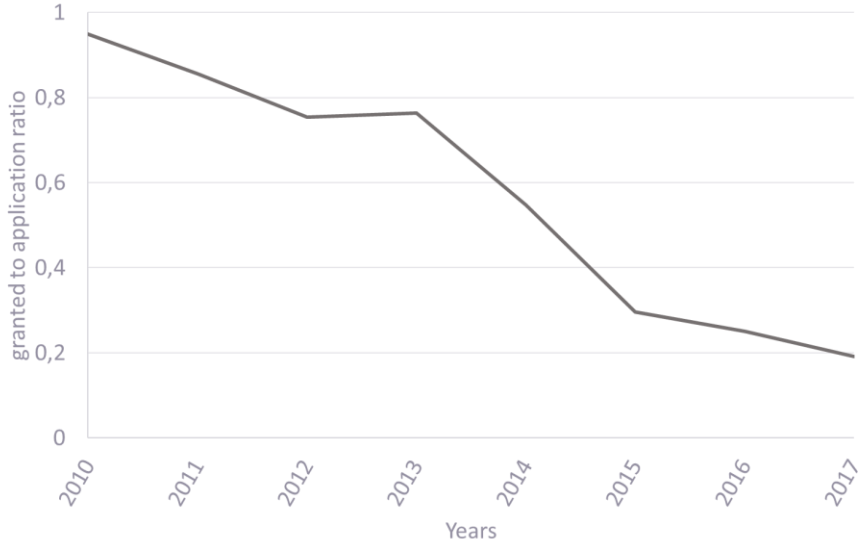
GLOBAL PATENT SET - GRANTED VS APPLICATION





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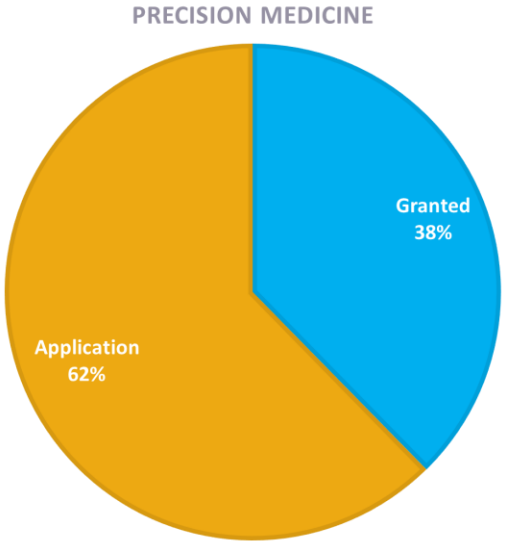
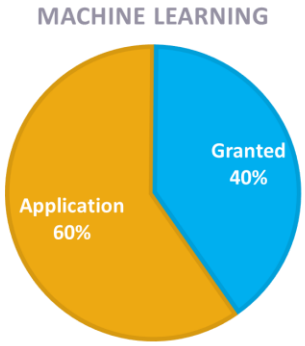
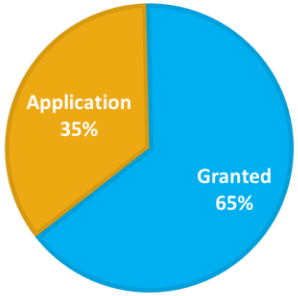
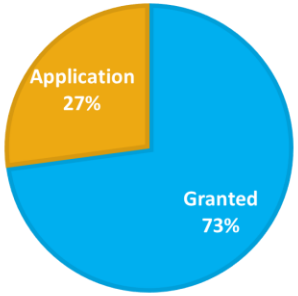
GLOBAL PATENT SET - GRANTED VS APPLICATION









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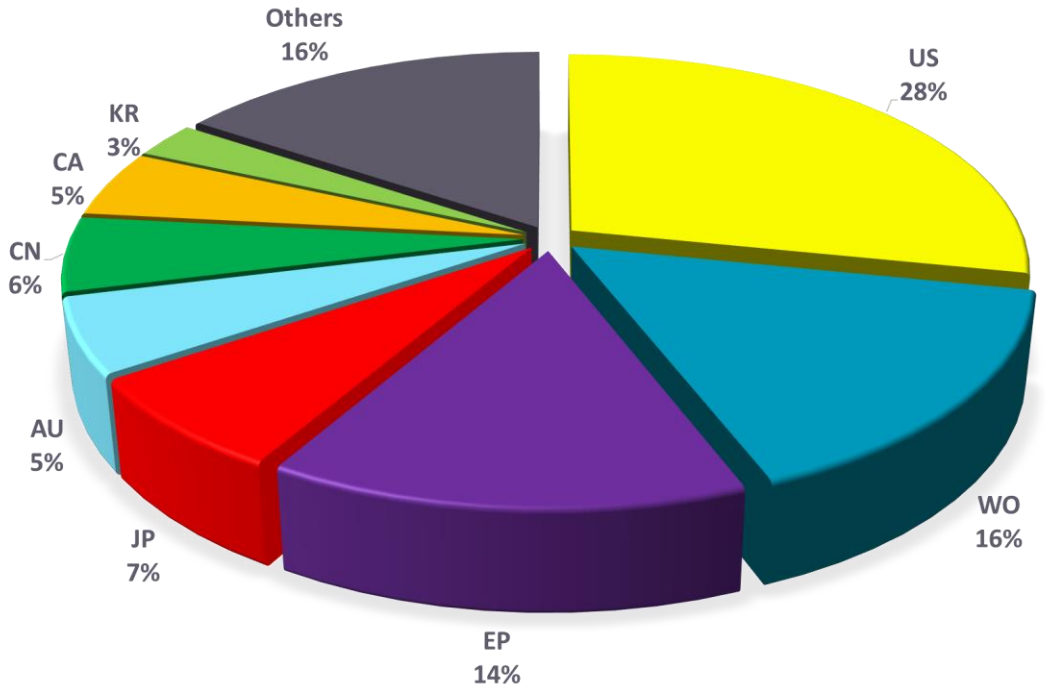
GLOBAL PATENT SET – COUNTRIES OF FILING



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EU-CN COMPARISON

European Countries

- EU members ✔
- European Free Trade Association ✔
- European Economic Area ✔
- Canada ✔
- Israel ✔
- Balkan countries **X** (other than Croatia, Greece ✔)
- Slovenia, Romania ✔ (not considered as Balkan)

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EU-CN COMPARISON – GEO LOCALISATION

Area	# of Families	# of Patents	I.I.
Global SET	12177	73656	6,0
EU Assignees	3383	18909	5,6
Chinese Assignees	573	1054	1,8

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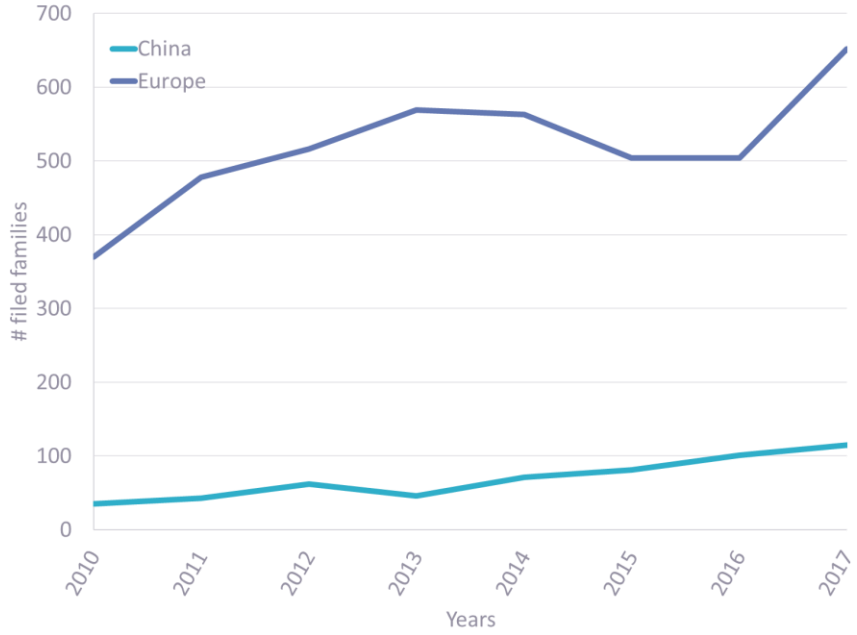
EU-CN COMPARISON – PATENT FILING Vs YEAR



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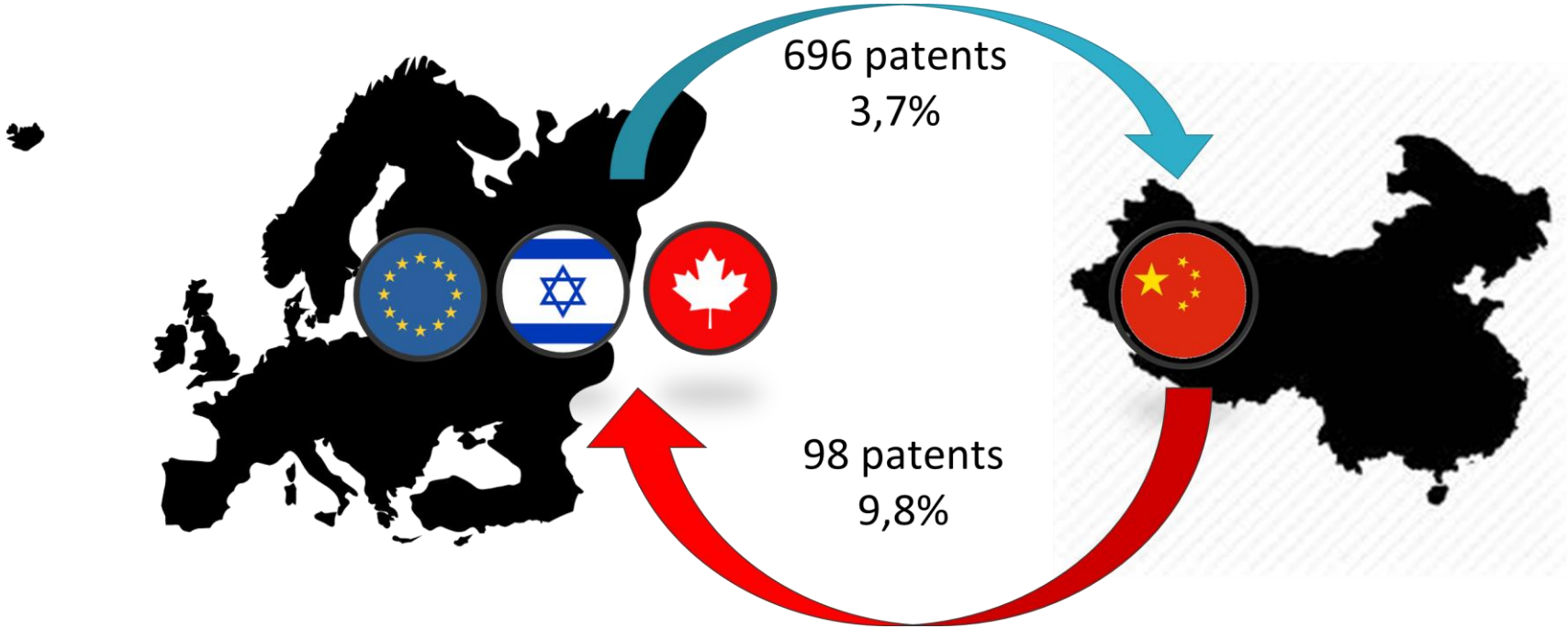
EU-CN COMPARISON



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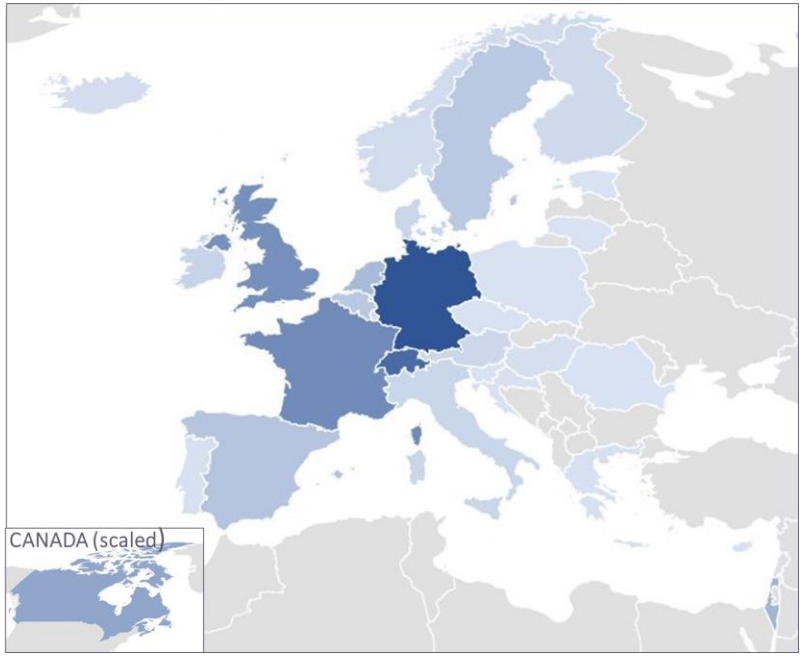
EU-CN COMPARISON - EU ASSIGNEE HEADQUARTERS

#	Assignee	# of Patents	% (total EU patent)
1	Germany	3703	19,5%
2	Swisse	3108	16,4%
3	France	2277	13,1%
4	United Kingdom	2144	12,0%
5	Canada	1594	8,4%
6	Israel	1168	6,2%
7	Nethelands	1033	5,4%
8	Spain	803	4,2%
9	Belgium	695	4,0%
10	Sweden	664	3,7%
11	Ireland	380	2,0%
12	Italy	351	2,0%
13	Denmark	335	1,9%
14	Austria	281	1,5%
15	Finland	242	1,3%
16	Norway	191	1,0%



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EU-CN COMPARISON - EU MAIN ASSIGNEES

Main European Assignees

#	Assignee	# of Families	# of Patents	I.I.	Headquarters (Country)
1	Roche	357	1343	3,8	Basilea (Swisse)
2	Inserm	247	691	2,8	Paris (France)
3	Novartis	182	858	4,7	Basilea (Swisse)
4	Philips	204	499	2,4	Amsterdam (Netherland)
5	CNRS	136	394	2,9	Paris (France)
6	Immatics Biotech..	114	447	3,9	Tuebingen (Germany)
7	Siemens	98	184	1,9	Munchen (Germany)
8	Nestec	91	400	4,4	Vevey (Swisse)
9	Varian Medical Systems	62	109	1,8	Zug (Swisse)
10	Université Rene Descartes	55	119	2,2	Paris (France)
11	University Of London	52	147	2,8	London (UK)
12	University Of Cambridge	46	198	4,3	Cambridge (UK)
13	Ass. Publique Hopitaux De Paris	44	115	2,6	Paris (France)
14	University Health Network	37	89	2,4	Totonto (Canada)
15	B.R.A.H.M.S.	33	121	3,7	Berlin (Germany)

~other 1000 assignees

Not European Main Assignees (Coassigned patent)

#	Co-Assignees	# of Families	# of Patents	I.I.	Country
1	Genentech	83	190	2,2	USA
2	Harvard University	43	127	2,9	USA
3	Univ. Of California	16	33	2.1	USA

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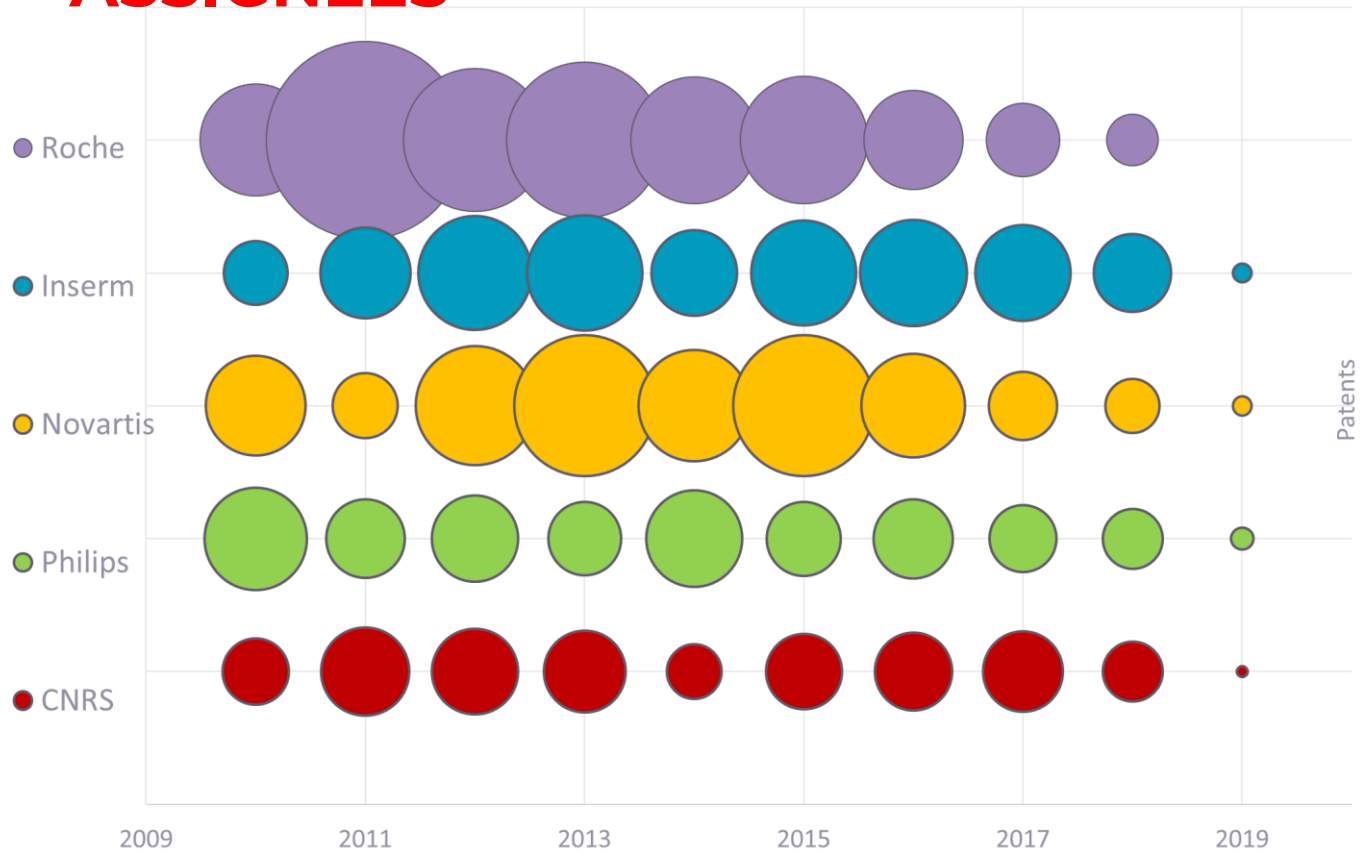
EU-CN COMPARISON - EU MAIN ASSIGNEES



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EU-CN COMPARISON – CN ASSIGNEES

Main Chinese Assignees

#	Assignee	# of Families	# of Patents	I.I.	Headquarters (Country)
1	University Of Hong Kong	35	73	2,1	Honk Hong
2	Fudan University	15	27	1,8	Shanghai
3	BGI Shenzken Company	14	37	2,6	Beijing
4	Chinese Academy Of Sciences	14	26	1,9	Beijing
5	Sun Yat Sen University	14	17	1,2	Guanzhou
6	Chengdu Xinjin Shifeng Med.App.Instr.	9	9	1,0	Chengdu
7	CROWN Bioscence	8	20	2,5	Taicang
8	Peking University	7	7	1,0	Beijing
9	Xiamen University	6	17	2,8	Xiamen
10	Kunming Univ. of Science and Technology	5	9	1,8	Kunming

~other 200 assignees

Not Chinese Main Assignees (Coassigned

#	Co-Assignees	# of Families	# of Patents	I.I:	Country
1	IBM	14	14	1	USA
2	Enanta Pharmaceuticals	13	27	2,1	USA
3	Bio Merieux	5	12	2,4	France
4	Academia Sinica	5	6	1,2	Taiwan

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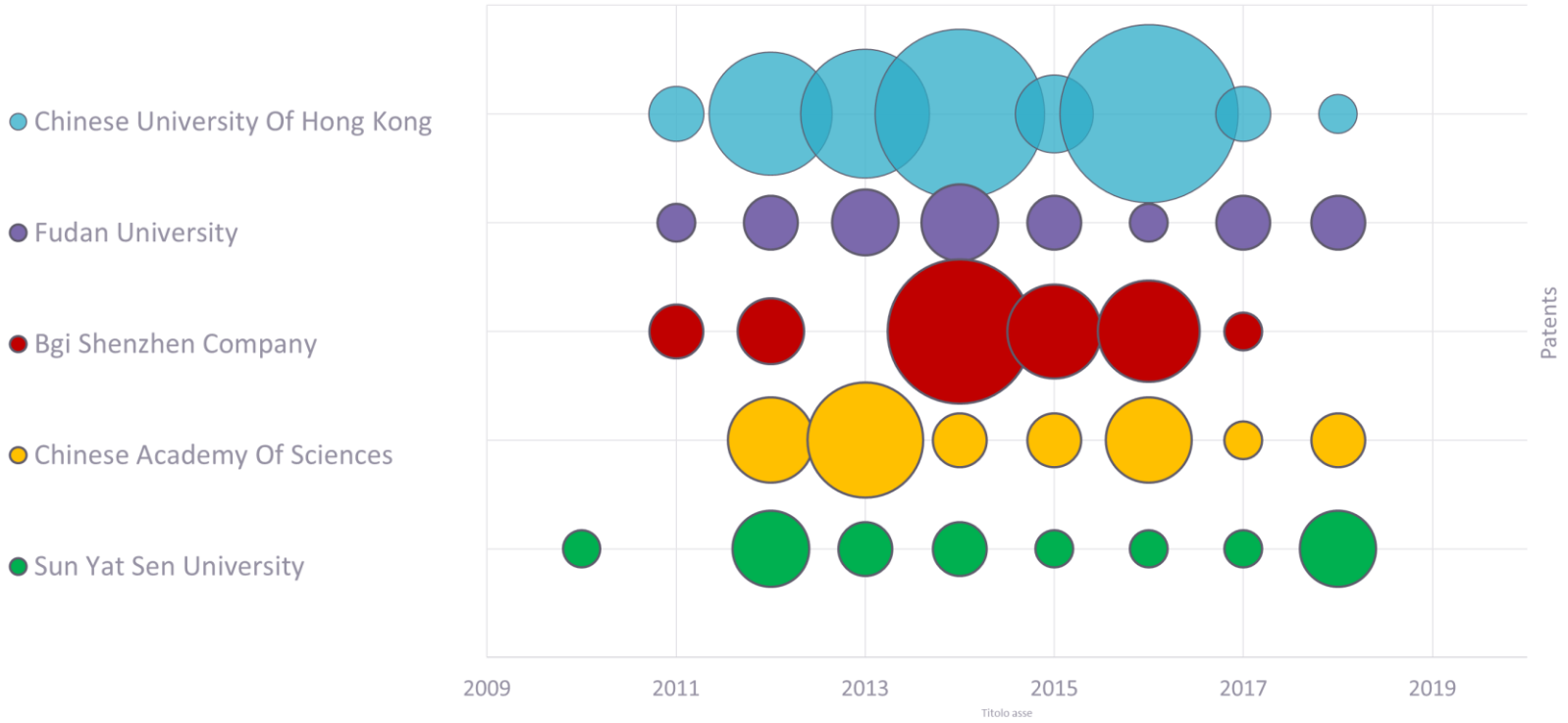
EU-CN COMPARISON – CN ASSIGNEES



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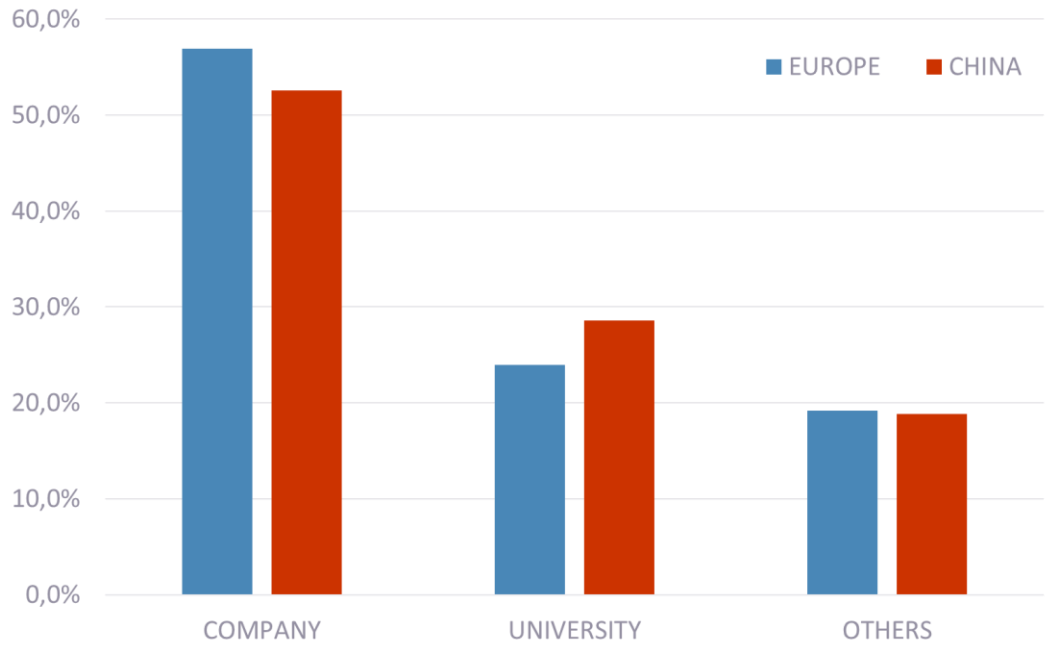
EU-CN COMPARISON

Private held companies VS public research organizzation



NOTE: Inventors as Assignees are not considered

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EU-CN COMPARISON| CO-ASSIGNEE - COLLABORATION

DEFINITIONS

- **CO-ASSIGNEED:** patent having at least 1 chinese assignee and at least 1 EU assignee
- **COLLABORATION:** patent of a family having at least 1 chinese assignee and 1 EU assignee

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EU-CN COMPARISON | COASSIGNED PATENTS

26 EU-CN co-assigned patents

#	Country	# of Patents
1	France	19
2	United Kingdom	6
3	Swisse	6
4	Canada	5
5	Israel	4
6	Germany	3

#	Assignee (Companies and research insitututes)	# of Patents	Country
1	Biomérieux	7	France
2	IBM (CHINA)	7	China
3	IBM (UK)	6	UK
4	PATHWAY PHARMACEUTICALS	4	China
5	Roche	4	Swisse
6	INSERM	4	France
7	BASF (DE)	2	Germany
8	BASF (CN)	2	China
9	CNRS	2	France
10	INSTITUT PASTEUR	2	France
11	HOSPICES CIVILS DE LYON	2	France
12	UNIVERSITE CLAUDE BERNARD LYON 1	2	France
13	IBM (DE)	1	Germany
14	Arius research	1	Canada

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EU-CN COMPARISON | COLLABORATION PATENTS

140 collaboration patents

#	Country	# of Fam.	# of Patents
1	France	8	68
2	United Kingdom	7	25
3	Swisse	4	41
4	Israel	3	6
5	Germany	2	17
6	Canada	2	14
7	Cyprus	1	14

Other involved countries: USA (28 pat.), Singapore (12 pat.)

#	Assignee (Companies and research insitututes)	# of Fam.	# of Patents	Country
1	IBM (CHINA)	7	25	China
2	IBM (GERMANY)	7	25	Germany
3	Bio merieux	3	23	France
4	Inserm	3	14	France
5	Pathway pharmaceuticals	3	6	China
6	Novartis	2	20	Swisse
7	BASF (CHINA)	2	17	China
8	BASF (Germany)	2	17	Germany
9	Institut Pasteur	1	12	France
10	C.N.R.S.	2	2	France
11	Hospices civils de Lyon	2	2	France
12	Shanghai Univ.	2	2	China
13	Xigen Inflammation	1	14	Cyprus
14	Arius Research	1	14	Canada
15	ROCHE	1	12	Swisse
16	Philip Morris	1	9	Swisse
17	Canada Cancer and Aging Lab.	1	2	Canada

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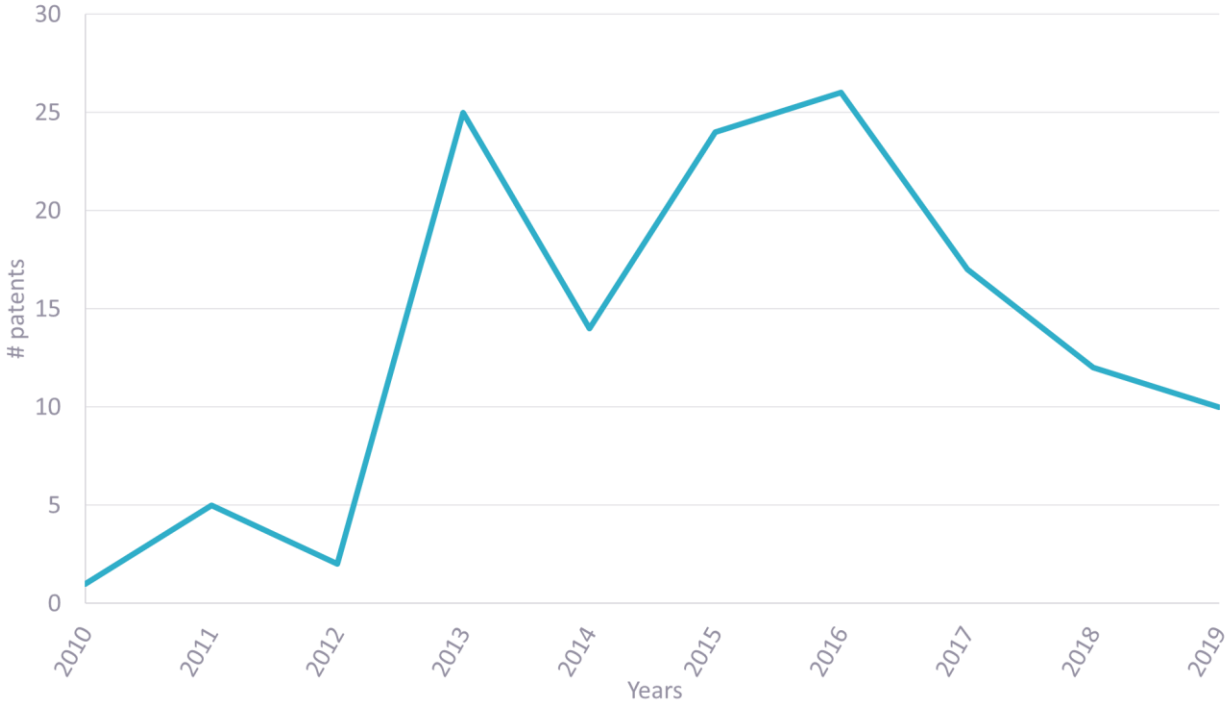
EU-CN COMPARISON | COLLABORATION VS YEARS



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Definition

TRADITIONAL CHINESE MEDICINE

Traditional Chinese medicine (**TCM**) is a branch of traditional medicine that is said to be based on more than 2500 years of Chinese medical practice that includes various treatments. TCM is widely used in the Sinosphere where it has a long history, and in later years it is also practiced outside of China.

One of the basic tenets of TCM is that the body's vital energy is circulating through channels, called meridians, that have branches connected to bodily organs and functions. Concepts of the body and of disease used in TCM reflect its ancient origins and its emphasis on dynamic processes over material structure, similar to European humoral theory. (Source: *Wikipedia*)

The diagnosis and treatment of traditional Chinese medicine need to adjust the systemic skills based on the patient's unique symptoms, and the treatment plan varies from person to person. Traditional Chinese medicine not only treats a certain disease, but also needs to systematically improve the physical quality through the improvement of the entire body's functions to treat the disease.

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TRADTIONAL CHINESE MEDICINE - PATENT SET

Field of Interest

- Procedure of traditional chinese medicine (defined as a branch of “alternative medicine” in Western world)
- Acupuncture, cupping therapy, moxibustion, reflexology
- Traditional Chinese herbal medicine
- Traditional Chinese massage methods and instruments
- Patents claiming or describing procedures or instruments declared as traditional Chinese medicine

Patent Set

- ~197K patents (~175k families)
- 97% precision

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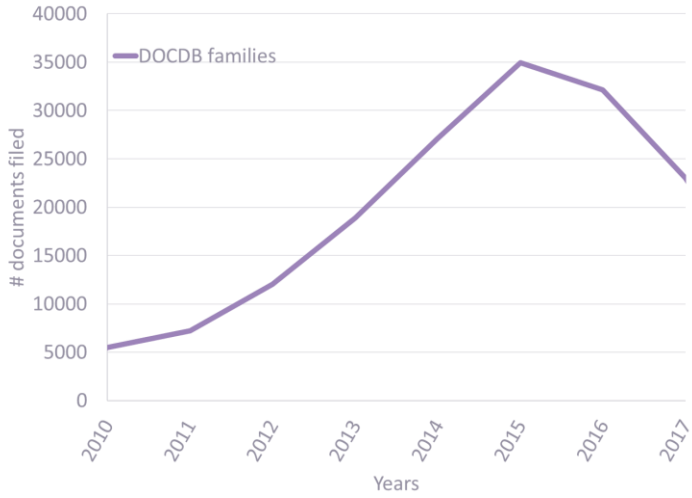
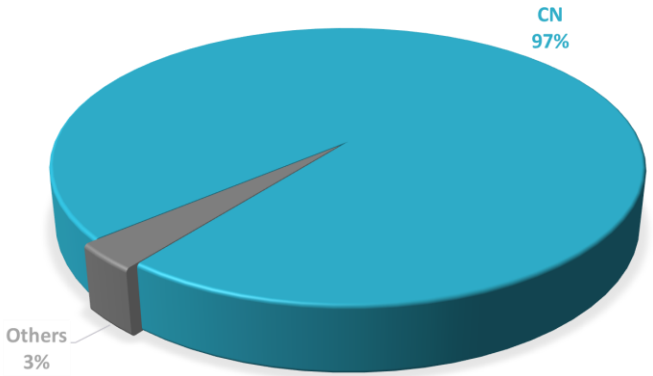
TRADTIONAL CHINESE MEDICINE – FILING DATES





WE FOUND 206 PATENTS THAT MET PM AND TCM CRITERIA. THESE DATA SUGGEST THAT TCM PRESENTS SOME COMMON GROUND WITH PM APPROACHES TO TREAT MEDICAL DISORDERS.

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TRADTIONAL CHINESE MEDICINE - ASSIGNEES

#	Assignee	# of Families	# of Patents	Country
1	Guangxi University	591	618	China
2	Henan University	537	669	China
3	Chengdu Feilong Water Treatment Tech. Institute	434	434	Cina
4	Sichuan Jintang Haina Biomedicine Tech. Institute	371	371	China
5	Qingdao Xinlide Trad. Chin. Med. Technology Research	324	324	China
6	Nanjing University Of Chinese Medicine	309	403	China
7	Beijing Lvyuan Qiuzheng Tech. Develop. Company	258	258	China
8	Suzhou Tianling Chin. Trad. Med.	255	273	China
9	Qingdao Municipal Hospital	249	316	China
10	Hunan University Of Chinese Medicine	222	237	China

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SCIENTIFIC MAPPING

SCIENTIFIC MAPPING

- Part 1: Global paper set analysis
- Part 2: EU-CN compared statistics
- Part 3: China-EU collaboration

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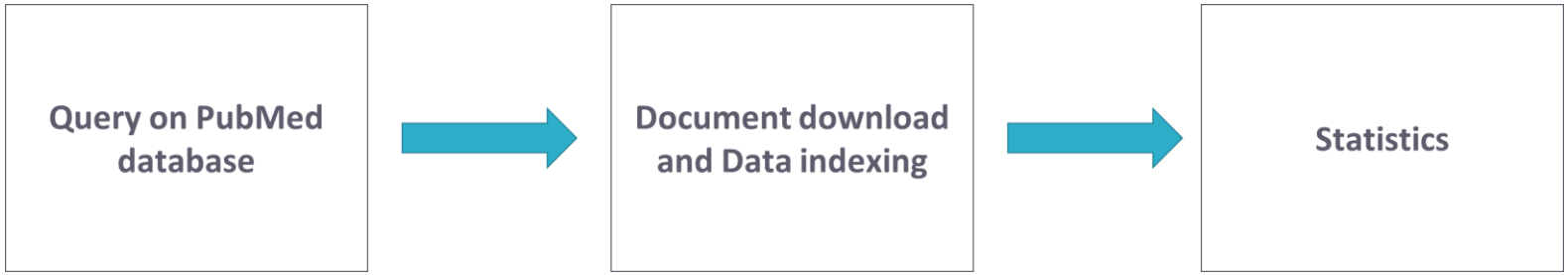
SCIENTIFIC MAPPING - WORKFLOW



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GLOBAL PAPER SET - INFO

DATABASE: PubMed

QUERY STRATEGY: Hybrid approach, carried out merging two different set

Set 1) "precision medicine" and "personalized medicine" as MeSH terms

Set 2) customized query, using keywords

Note*: this set includes non-English written article only if at least one of title, abstract or keyword are available in PubMed in English*

QUERY FILTERS

- Human
- Years from 2010 to 2020 (included)

RESULTS

- 41 535 scientific papers (200 835 affiliation)

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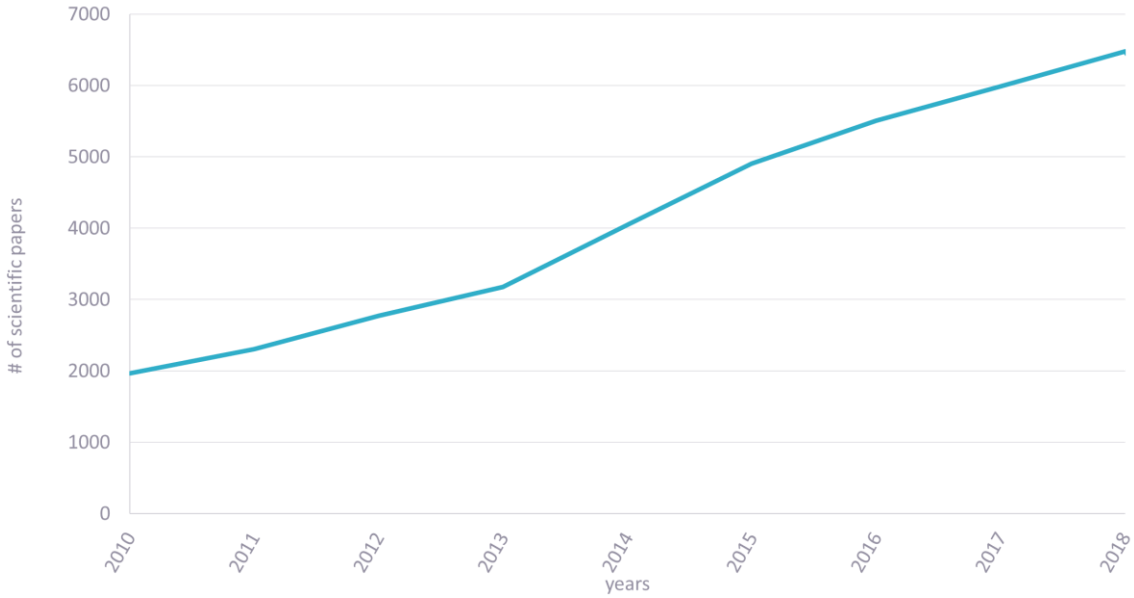
GLOBAL PAPER SET - PAPER PUBBLICATION Vs YEARS

This analysis was carried out in March 2020

PubMed database could be partially updated with 2019 and 2020 publications.

Some countries or some journals could provide articles to PubMed with a bigger delay.



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GLOBAL PAPER SET

Authors' institutional affiliation

Assessing predictions of the impact of variants on splicing in CAGI5.

Mount SM[1], Avsec Ž[2], Carmel L[3], Casadio R[4], Çelik MH[2], Chen K[5], Cheng J[2], Cohen NE[3,6], Fairbrother WG[7], Fenesh T[8], Gagneur J[2], Gotea V[9], Holzer T[8], Lin CF[10], Martelli PL[4], Naito T[11], Nguyen TYD[2], Savojardo C[4], Unger R[8], Wang R[12,13], Yang Y[5], Zhao H[14].

Author information

1 Department of Cell Biology and Molecular Genetics, University of Maryland, College Park, Maryland.
2 Department of Informatics, Technical University of Munich, Garching, Germany.
3 Department of Genetics, The Alexander Silberman Institute of Life Sciences, The Hebrew University of Jerusalem, Jerusalem, Israel.
4 Department of Pharmacy and Biotechnology, Biocomputing Group, University of Bologna, Bologna, Italy.
5 School of Data and Computer Science, Sun Yat-sen University, Guangzhou, China.
6 The integrated program for Computer Science and Computational Biology, School of Computer Science and Engineering, The Hebrew University of Jerusalem, Jerusalem, Israel.
7 Department of Molecular Biology, Cell Biology, and Biochemistry, Center For Computational Biology, Brown University, Providence, Rhode Island.
8 The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel.
9 National Human Genome Research Institute (NHGRI), National Institutes of Health (NIH), Bethesda, Maryland.
10 Translational Informatics, DNAnexus, Mountain View, California.
11 Department of Neurology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan.
12 Department of Bioengineering, University of California, Berkeley, California.
13 Department of Plant and Molecular Biology, University of California, Berkeley, California.
14 Guangdong Provincial Key Laboratory of Malignant Tumor Epigenetics and Gene Regulation, Sun Yat-sen Memorial Hospital, Sun Yat-sen University, Guangzhou, China.

n° of papers vs n° of affiliations

China:
- 1 paper
- 2 affiliation

Italy:
- 1 paper
- 1 affiliation

Dep. of informatics, Tech. Univ. Of Munich:
- 1 paper

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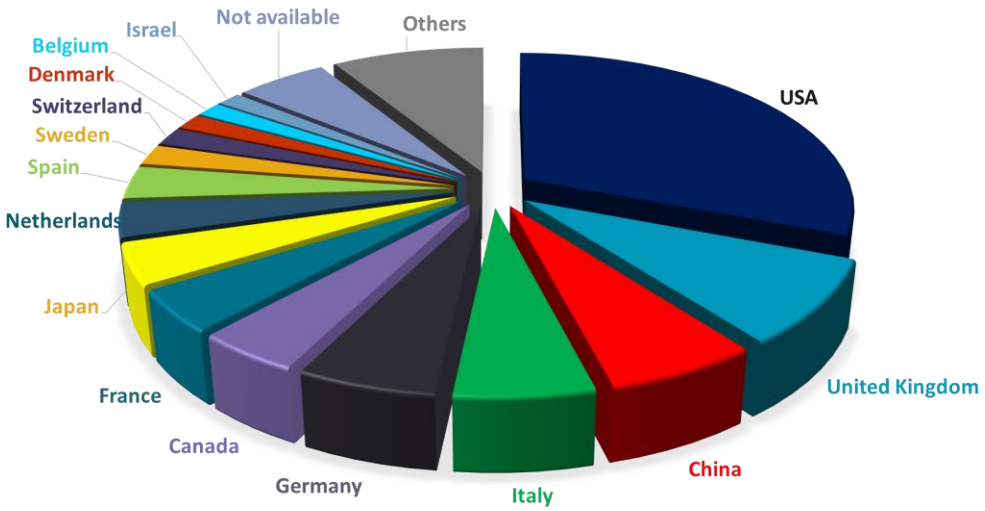
GLOBAL PAPER SET - COUNTRIES

#	Country	# of papers
1	USA	16108
2	United Kingdom	4576
3	China	3307
4	Italy	3019
5	Germany	3001
6	Canada	2274
7	France	2268
8	Netherlands	2216
9	Japan	1855
10	Spain	1772
11	Sweden	1104
12	Switzerland	981
13	Denmark	845
14	Belgium	780
15	Israel	728



Scientific article is assigned to a country if at least an affiliation of said country is present

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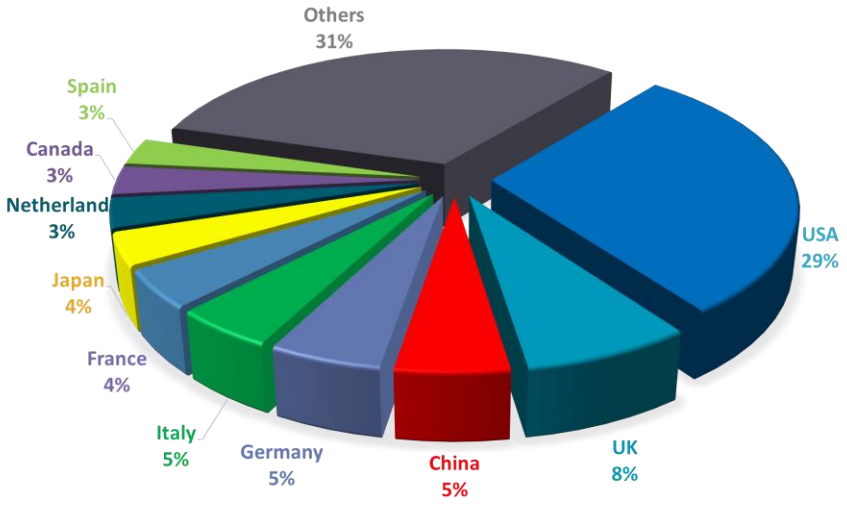
GLOBAL PAPER SET – COUNTRIES (AFFILIATION)

#	Country	# of affiliations	% of total papers
1	USA	58639	29,2%
2	UK	15131	7,5%
3	China	10178	5,0%
4	Germany	10127	5,0%
5	Italy	9143	4,5%
6	France	8577	4,2%
7	Japan	7224	3,6%
8	Netherlands	6638	3,3%
9	Canada	6335	3,1%
10	Spain	6052	3,0%
11	Denmark	2737	1,3%
12	Sweden	2571	1,2%
13	Swisse	2096	1,0%
14	Finland	1874	0,9%
15	Poland	1561	0,7%



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GLOBAL PAPER SET – TOP AFFILIATIONS

#	Affiliation	# of papers	Country
1	Department of Clinical Pharmacology, Xiangya Hospital, Central South University, Changsha 410008, China	320	*China*
2	Center of Excellence in Genomic Medicine Research, King Abdulaziz University, Jeddah, Saudi Arabia.	217	*Saudi Arabia*
3	The Jackson Laboratory for Genomic Medicine, Farmington, CT, USA.	210	*USA*
4	Wellcome Trust Centre for Human Genetics, University of Oxford, Oxford, UK.	178	*UK*
5	Department of Genomic Medicine, The University of Texas MD Anderson Cancer Center, Houston, Texas.	176	*USA*
6	Department of Molecular and Human Genetics, Baylor College of Medicine, Houston, TX 77030, USA	157	*USA*
7	Institute of Clinical Pharmacology, Hunan Key Laboratory of Pharmacogenetics, Central South University, Changsha, China.	151	*China*
8	Center for Genomic Medicine, Massachusetts General Hospital, Boston, MA, USA.	150	*USA*
9	Center for Genomic Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan.	125	*Japan*
10	Department of Pathology and Genomic Medicine, Houston Methodist Hospital, Houston, Texas.	117	*USA*
11	Department of Genetics, Stanford University, Stanford, California, USA.	112	*USA*
12	Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA.	108	*USA*
13	Department of Medicine, Harvard Medical School, Boston, MA, USA.	107	*USA*
14	Institute of Genomic Medicine, Wenzhou Medical University, Wenzhou, China.	106	*China*
15	Department of Epidemiology, Erasmus Medical Center, Rotterdam, the Netherlands.	88	*The Netherlands*
16	Institute of Molecular and Genomic Medicine, National Health Research Institutes, Miaoli, Taiwan.	81	*Taiwan*
17	Department of Biostatistics, Boston University School of Public Health, Boston, MA, USA.	79	*USA*
18	Centre for Cancer Genetic Epidemiology, Department of Public Health and Primary Care, University of Cambridge, Cambridge, UK.	76	*UK*
19	Department of Psychiatry, University of California San Diego, La Jolla, CA, United States	76	*USA*
20	Department of Human Genetics, Radboud University Medical Center, Nijmegen, The Netherlands.	74	*The Netherlands*

PubMed database provides different name for a single affiliation. Moreover the name can be expressed in different formats. We performed a database "normalization" in order to assign the number of submitted paper to a single affiliation. For example, symbols and punctuation are deleted, some words as "centre" and "center" can be standardized, and so on. In such way it is possible to assign a paper to affiliation even if the name of the affiliation itself is provided in a different format. However the global number of papers assigned to each affiliation might be underestimated because of errors in database or complex name formats.

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GLOBAL PAPER SET – JOURNALS

#	Country	# of papers	Impact Factor (2018)
1	Pharmacogenomics	2179	2.265
2	PLoS One	825	2.776
3	Clinical Pharmacology & Therapeutics	395	6.336
4	Scientific reports	380	4.122
5	Oncotarget	314	4.525
6	Nature	283	43.070
7	International Journal of Molecular Sciences	243	4.183
8	Methods in Molecular Biology	239	10.71
9	Pharmacogenetic & Genomics	231	1.90
10	Clinical Cancer research	221	8.911

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EU-CN COMPARISON

European Countries

Included in STATS ✔

Austria, Belgium, Canada Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, , Lietchtenstein Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Romania, Slovenia, Sweden, Switzerland, UK

Excluded from STATS X

Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgary, Georgia, Kosovo, Macedonia, Moldova, Monaco, Montenegro, Russia, San Marino, Serbia, Turkey, Ukraine, Vatican City

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Cooperation between China and Europe in Personalised Medicine

EU-CN COMPARISON – AFFILIATIO REGION

Area	# of Articles	# of Affiliations
Global SET	41 535	200 835
European Affiliation	16 823	83 157
Chinese Affiliation	3 307	10 178

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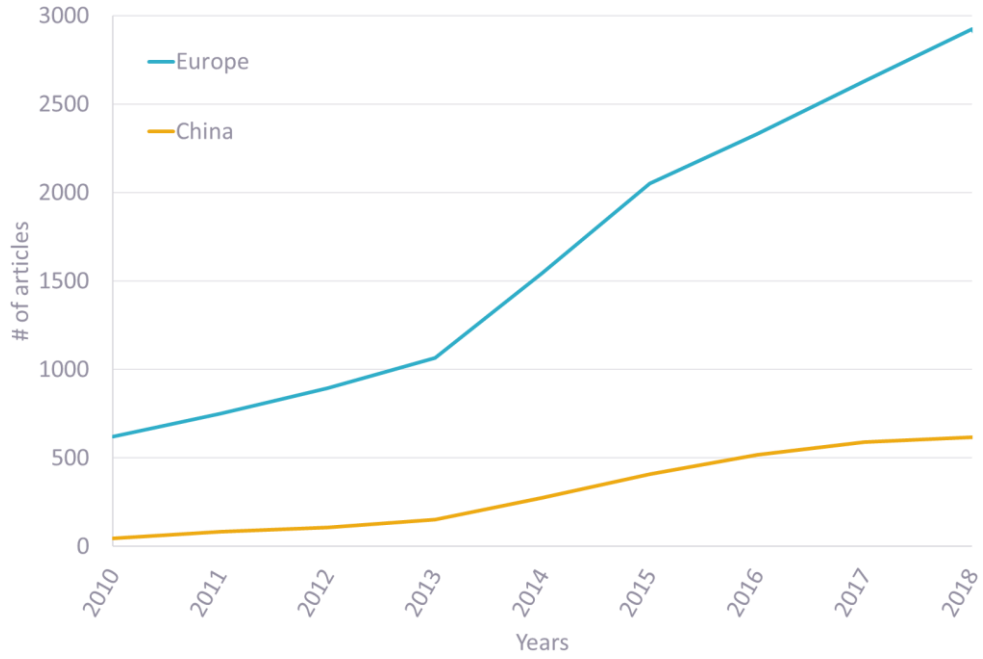
EU-CN COMPARISON - PAPER PUBBLICATIONS VS YEARS



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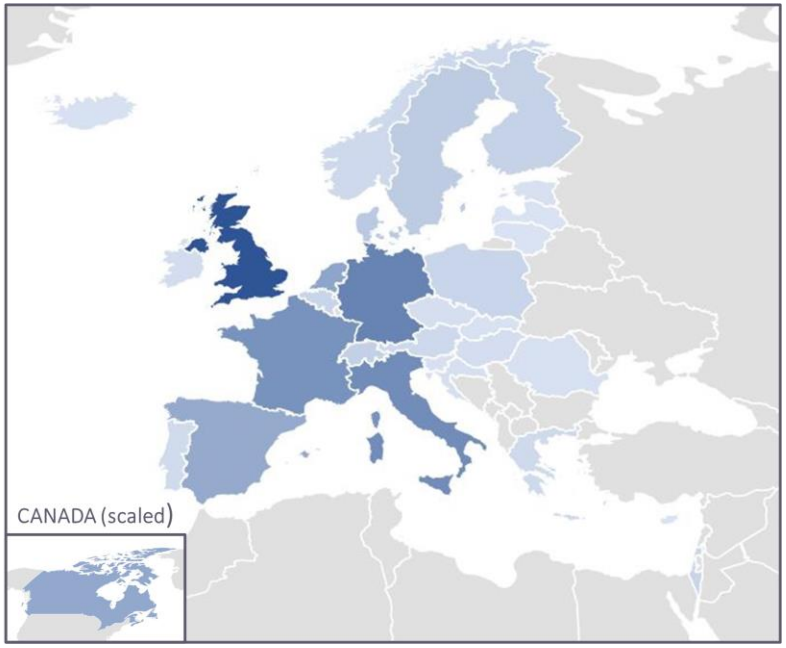
EU-CN COMPARISON – EU AFFILIATION COUNTRY

#	Assignee	# of Affiliations	% (total EU papers)
1	U.K.	15131	18,20%
2	Germany	10127	12,18%
3	Italy	9143	10,99%
4	France	8577	10,31%
5	Netherlands	6638	7,98%
6	Canada	6335	7,62%
7	Spain	6052	7,28%
8	Denmark	2737	3,29%
9	Sweden	2571	3,09%
10	Swisse	2096	2,52%
11	Finland	1874	2,25%
12	Poland	1561	1,88%
13	Belgium	1534	1,84%
14	Israel	1492	1,79%
15	Austria	1055	1,27%



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Cooperation between China and Europe in Personalised Medicine

EU-CN COMPARISON – TOP EU AFFILIATION

#	Affiliation	# of papers	Country
1	Wellcome Trust Centre for Human Genetics, University of Oxford, Oxford, UK.	178	*UK*
2	Department of Epidemiology, Erasmus Medical Center, Rotterdam, the Netherlands.	88	*Netherlands*
3	Centre for Cancer Genetic Epidemiology, Department of Public Health and Primary Care, University of Cambridge, Cambridge, UK.	76	*UK*
4	Department of Human Genetics, Radboud University Medical Center, Nijmegen, The Netherlands.	74	*Netherlands*
5	National Institute for Health and Welfare, Helsinki, Finland.	65	*Finland*
6	Department of Internal Medicine, Erasmus Medical Center, Rotterdam, the Netherlands.	65	*Netherlands*
7	Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden.	64	*Sweden*
8	German Cancer Consortium (DKTK), German Cancer Research Center (DKFZ), Heidelberg, Germany.	63	*Germany*
9	Estonian Genome Center, University of Tartu, Tartu, Estonia.	58	*Estonia*
10	German Center for Diabetes Research (DZD), Neuherberg, Germany.	54	*Germany*
11	Section of Pharmacogenetics, Department of Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden.	52	*Sweden*
12	Department of Clinical and Experimental Medicine, University of Pisa, Pisa, Italy.	49	*Italy*
13	Institute for Molecular Medicine Finland, University of Helsinki, Helsinki, Finland.	48	*Finland*
14	Department of Biostatistics, University of Liverpool, Liverpool, UK.	46	*UK*
15	Institute of Human Genetics, Technische Universitat Munchen, Munich, Germany.	41	*Germany*
16	Division of Cancer Epidemiology, German Cancer Research Center (DKFZ), Heidelberg, Germany.	40	*Germany*
17	Department of Molecular Genetics, University of Toronto, Toronto, Ontario, Canada.	38	*Canada*
18	Icelandic Heart Association, Kopavogur, Iceland.	37	*Iceland*
19	Department of Clinical Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark.	36	*Denmark*
20	Department of Genetics and Pathology, Pomeranian Medical University, Szczecin, Poland.	36	*Poland*

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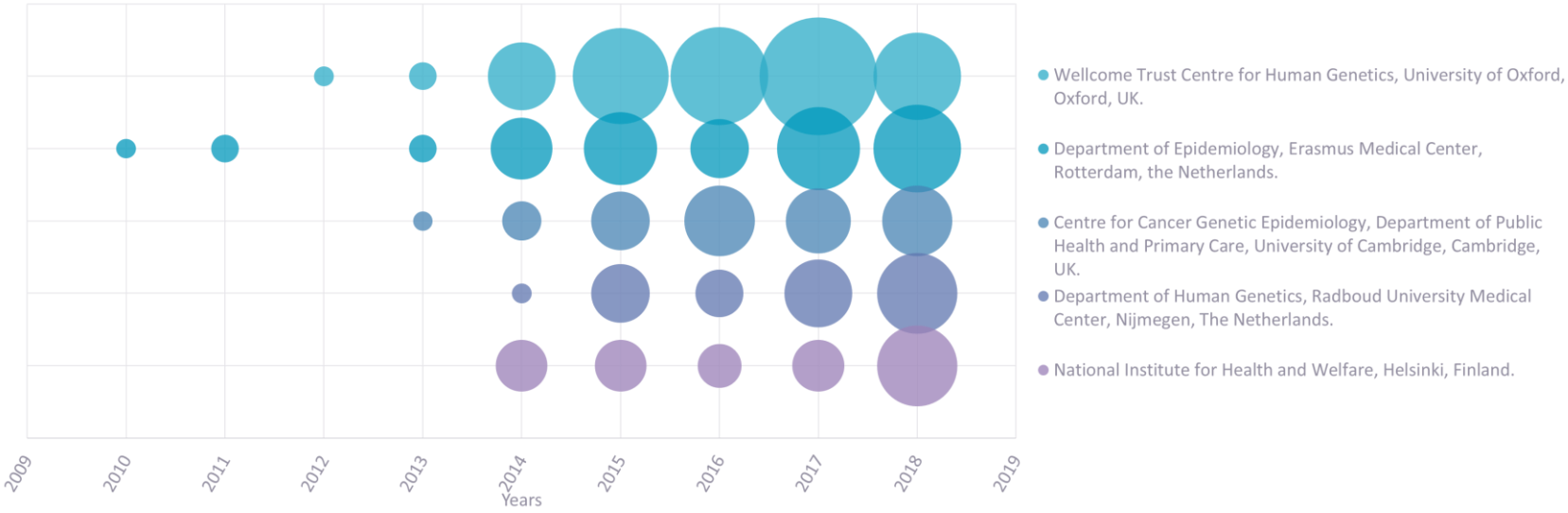
Cooperation between China and Europe in Personalised Medicine

EU-CN COMPARISON – TOP EU AFFILIATION



SINO-EU PerMed

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EU-CN COMPARISON – TOP CN AFFILIATION

#	Affiliation	# of papers
1	Department of Clinical Pharmacology, Xiangya Hospital, Central South University, Changsha	320
2	Institute of Clinical Pharmacology, Hunan Key Laboratory of Pharmacogenetics, Central South University, Changsha	151
3	Institute of Genomic Medicine, Wenzhou Medical University, Wenzhou	106
4	National Clinical Research Center for Geriatric Disorders, 8Xiangya Road, Changsha 410008, Hunan.	52
5	Beijing Institutes of Life Science, Chinese Academy of Sciences, Beijing	49
6	BGI-Shenzhen, Shenzhen	49
7	Hunan Province Cooperation Innovation Center for Molecular Target New Drug Study, Hengyang	44
8	Bio-X Institutes, Key Laboratory for the Genetics of Developmental and Neuropsychiatric Disorders, Ministry of Education Shanghai Jiao Tong University, Shanghai	34
9	Department of Pharmacy, Xiangya Hospital, Central South University, Changsha	31
10	Engineering Research Center of Applied Technology of Pharmacogenomics, Ministry of Education, 1Xiangya Road, Changsha 410078, PR China	31
11	Department of Epidemiology, Shanghai Cancer Institute, Shanghai, China.	28
12	State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou 510060, China.	25
13	Institute of Genomic Medicine, College of Pharmacy, Jinan University, Guangzhou 510632, China.	24
14	Center for Systems Biology, Soochow University, No.Shizi Street, Suzhou, Jiangsu, 215006, China. bairong.shen@suda.edu.cn.	22
15	Beijing Tongren Eye Center, Beijing Tongren Hospital, Capital Medical University, Beijing, China.	21
16	Key Laboratory of High Altitude Environment and Genes Related to Diseases of Tibet Autonomous Region, School of Medicine, Xizang Minzu University, Xianyang, Shaanxi 712082, China	21
17	CAS Key Laboratory of Genome Sciences and Information, Beijing Institute of Genomics, Chinese Academy of Sciences, Beijing 100101, China	20
18	State Key Laboratory of Oncology in South China	16
19	Institute of Preventive Genomic Medicine, School of Life Sciences, Northwest University, Xi'an, 710069, China	16
20	Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China.	15

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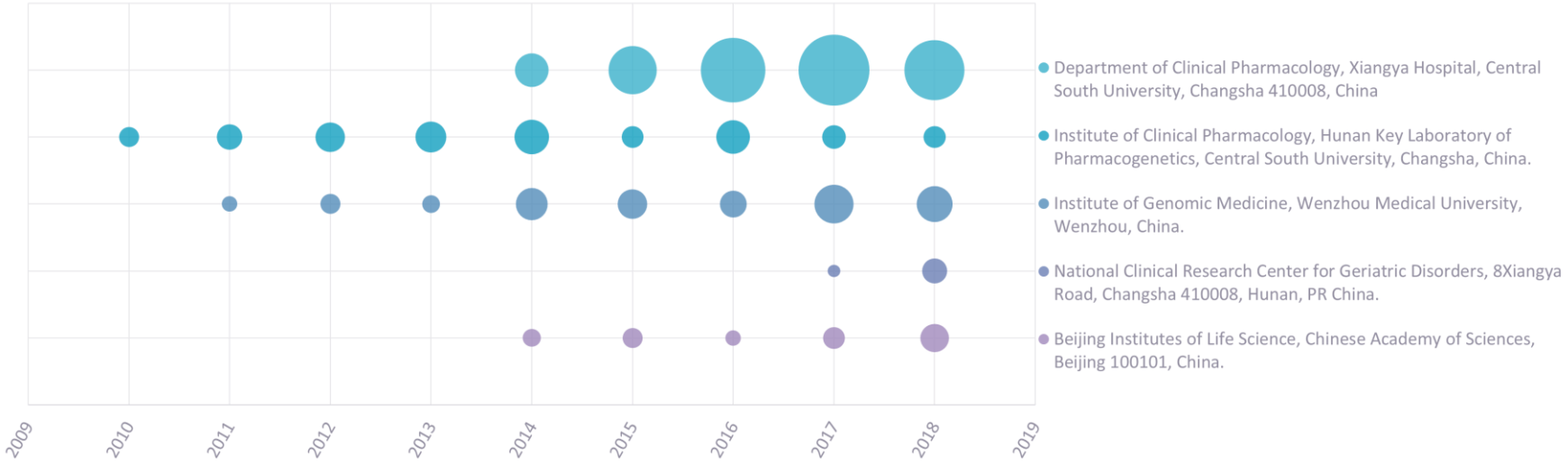
EU-CN COMPARISON – TOP CN AFFILIATION



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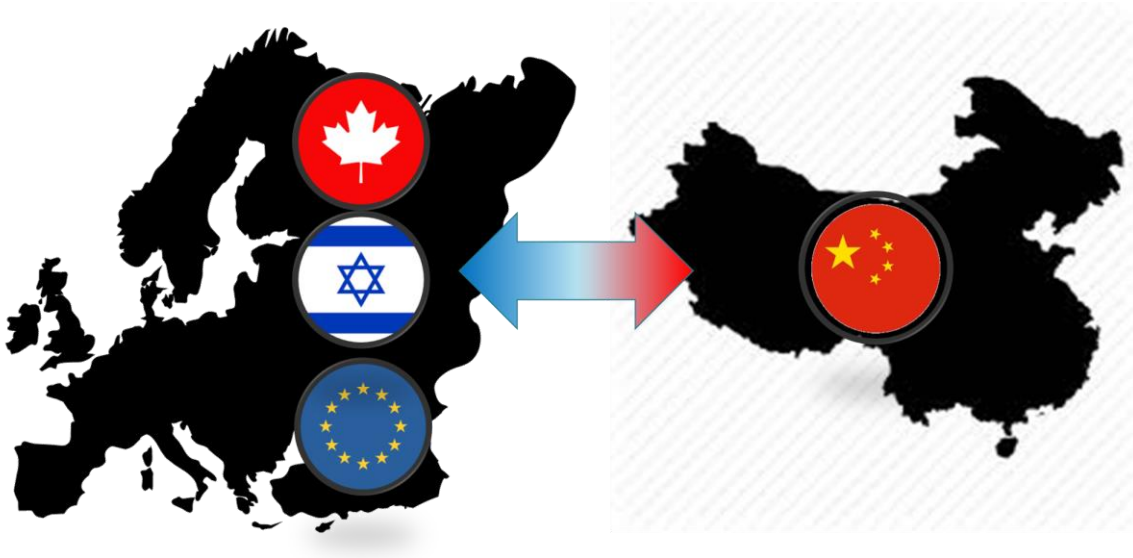
EU-CN COMPARISON – COLLABORATIONS

Definition:

scientific paper having at least 1 chinese affiliation and at least 1 EU affiliation



Results

- 447 collaboration papers

- 13,5% of chinese papers
- 2,6% of EU papers
- 1,1% of global papers

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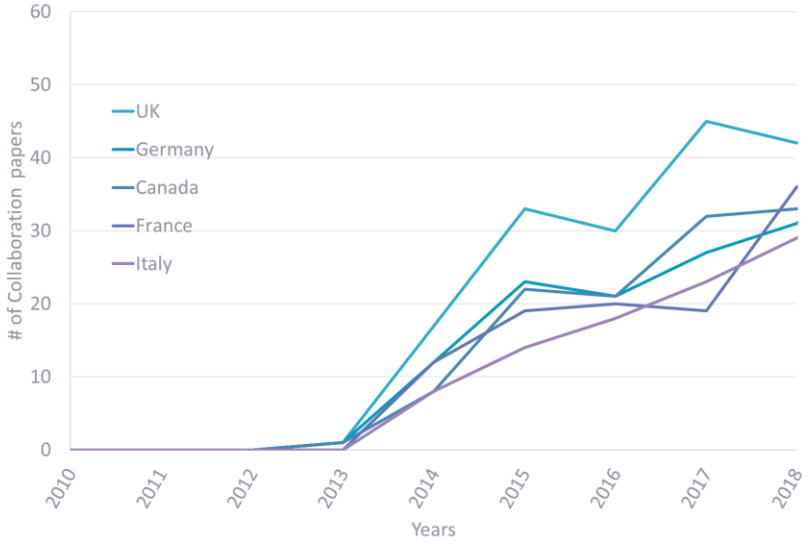
Cooperation between China and Europe in Personalised Medicine

EU-CN COMPARISON – EU COUNTRIES COLLABORATIONS

#	Country	# of collaboration
1	UK	220
2	Germany	160
3	Canada	154
4	France	136
5	Italy	127
6	Netherlands	127
7	Sweden	104
8	Denmark	93
9	Spain	87
10	Israel	71
11	Finland	70
12	Switzerland	60
13	Belgium	57
14	Austria	53
15	Greece	52



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Cooperation between China and Europe in Personalised Medicine

EU-CN COMPARISON – EU COUNTRIES COLLABORATIONS

#	Affiliation	# of collaborations	Country
1	Department of Clinical Pharmacology, Xiangya Hospital, Central South University, Changsha	115	*China*
2	Institute of Clinical Pharmacology, Central South University	75	*China*
3	Engineering Research Center of Applied Technology of Pharmacogenomics, Ministry of Education, Changsha	18	*China*
4	State Key Laboratory of Oncology in South China	16	*China*
5	Department of Clinical Physiology and Nuclear Medicine, Turku University Hospital, Turku	14	*Finland*
6	University of Chinese Academy of Sciences, Beijing.	14	*China*
7	Estonian Genome Center, University of Tartu, Tartu	14	*Estonia*
8	Institute of Human Genetics, Technische Universitat Munchen, Munich	13	*Germany*
9	Institute of Genomic Medicine, Wenzhou Medical University, Wenzhou	13	*China*
10	Research Centre of Applied and Preventive Cardiovascular Medicine, University of Turku, Turku	13	*Finland*

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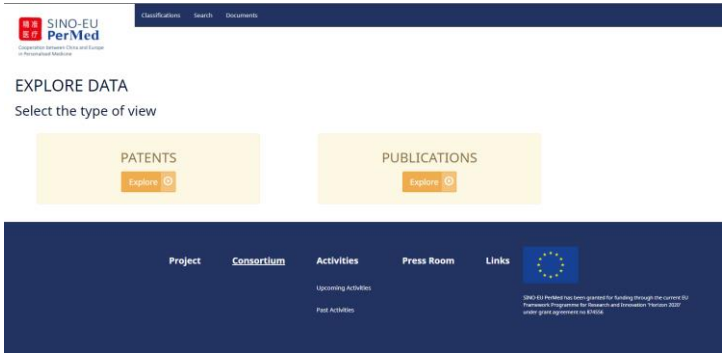
OTHER OUTCOMES



Common database

Scientific paper

SWOT ANALYSIS

SINO-EU PerMed

Cooperation between China and Europe in Personalised Medicine

Thank you for your attention

DLR-PT
Sabine Puch
Carolin Lange
Wolfgang Ballensiefen
Oksana Rogalski

HRB
Mairead O`Driscoll

JITTC
Yu Wang
Prisca Cen
Mingyue Shen
Chao Peng

TLS
Gianni D'Errico
Claudia Mariut
Andrea Frosini
Ilaria Romagnuolo

IFD
Ejner Moltzen
Matilde Soerensen

GIBH
Yong Xu
Huijuan Xu

SINO-EU PerMed has been granted for funding through the current EU Framework Programme for Research and Innovation 'Horizon 2020' under grant agreement no 874556

DLR-PT

Practice on Children's Growing Development based on Big Data in China

Yang Ji-Jiang（杨吉江）

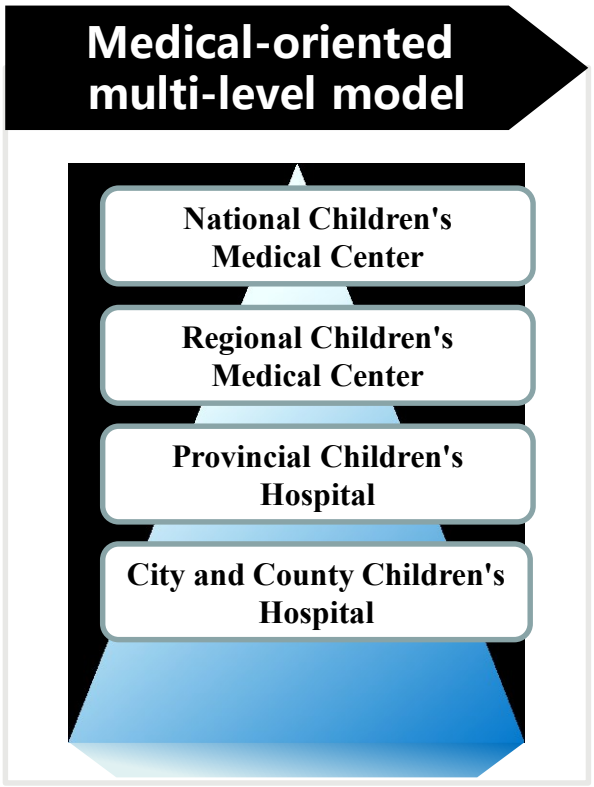
Engineering Research Center on Digital Medical and Health
Research Center for Pharmacovigilance IT and Data Science（PVID）
Tsinghua University

The Current Situation of Children's Health in China

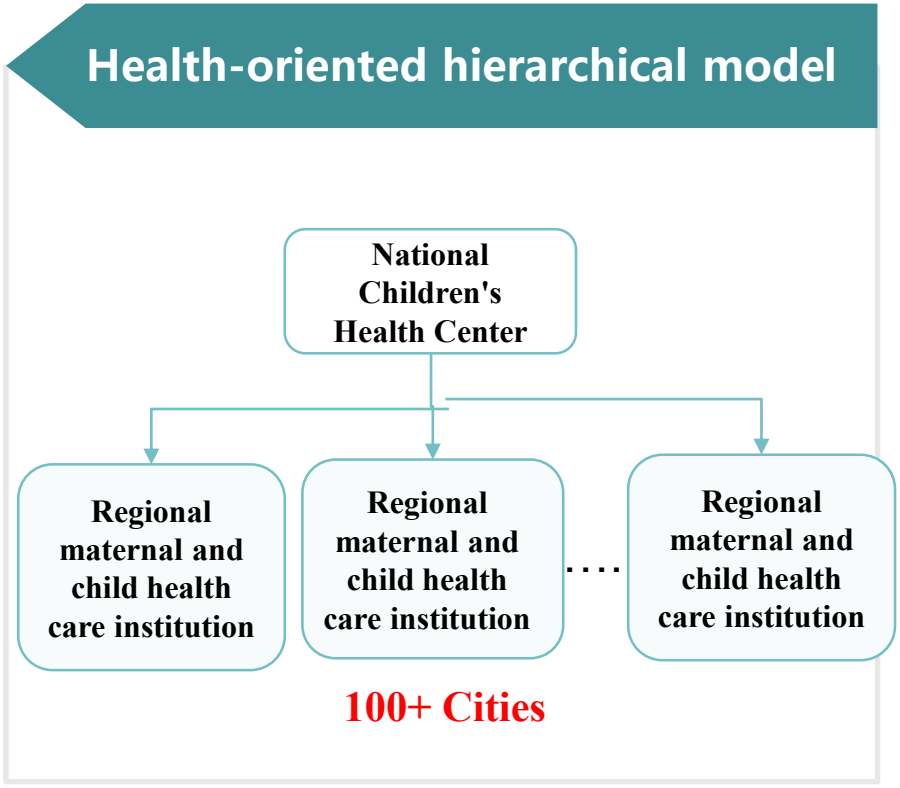
The survey data of the Adolescent Health and Medicine Professional Committee of the Chinese Medical Doctor Association (2017) shows:

- The proportion of abnormal psychological and behavioral development is 22.65%～45.58%;
- The proportion of abnormal growth and development is 48.57%～63.31%;
- In terms of sexual development, without medical verification,
  - 2.74% ~ 8.41% of girls were suspected to be precocious;
  - 3.45% ~ 22.08% were suspected to have delayed sexual development;
  - 3.38% ~ 11.87% of boys were suspected to be precocious;
  - 5.66% ~ 24.98% were suspected to have delayed sexual development;
- The first response when children's physical and mental health apprear problems:
  - Inquiring the Internet, which accounted for 31.15%;
  - Consulting specialized hospitals, which accounted for 34.94%

Children's Health Care Service System in China



Medical View



Health service view

Main issues of Children's Health in China

Screening

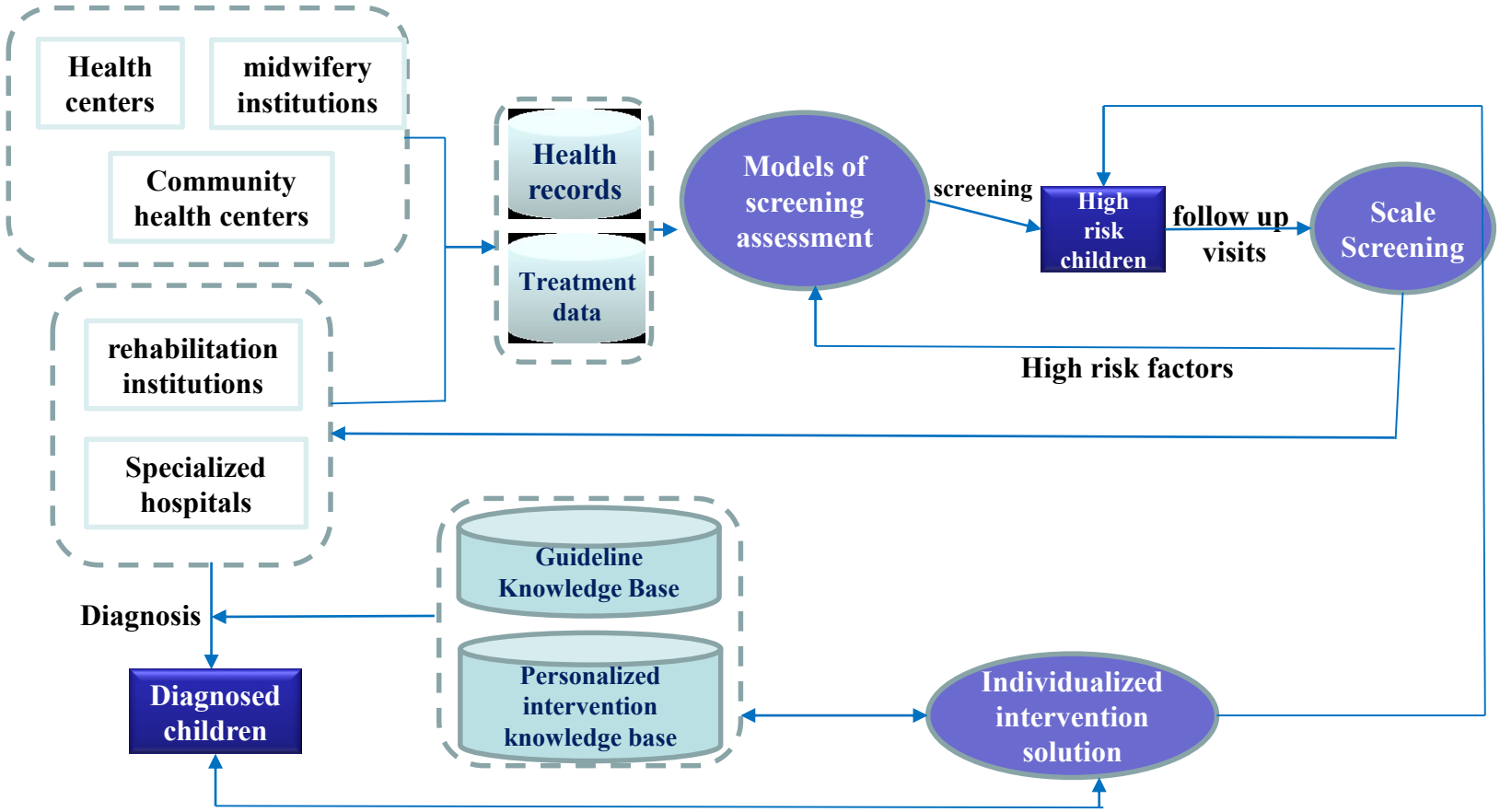
- Narrow coverage → Build regional platforms
- Incomplete data → Collect data dynamically and continuously
- Low efficiency and reliability → Establish an evaluation screening model
- High screening costs → Screen intelligently by data

intervention

- Insufficient knowledge and technology spreading ability → Build a knowledge base of disease guidelines
- Scarce expert resources → Build a knowledge base for personalized interventions
- Insufficient resources for therapeutic intervention sites → Remote mobile interventions
- Limited family economic resources → Establish early intervention channels
- Insufficient family involvement in treatment → Provide active knowledge services

Screening and active intervention service based on big data

Typical Structure of Health Screening Model in China



Typical Process for Precision Medical model

Real-time consultation data feedback

Precision Medical Supplementary Decision Making and Knowledge Base Cloud Service Platform

Natural Language Retrieval

Interactive query

Intelligent Recommendations

Precision Medical Model

Individual treatment model

Patients' information

Patients

Clinicians

Precision medical supplementary decision making solutions

Doctor workstation

Mobile client

Guidelines and Consensus Knowledge Base

Domestic and international precision medicine database

Literature Library

Typical Case Library

Precision Medical Collaborative

- Collect
- Sort
- Maintenance
- Update
- Qualify

Method (1) - Massive Data Analysis

Mining and analysis of massive health records and treatment data

- **Intelligent assessment**
- **Personalized treatment**
- **Proactive knowledge recommendation**

- **Based on the analysis of disease guideline norms, the knowledge map of autism monitoring and assessment for children of different ages is obtained to provide a basis for intelligent assessment.**
- **Based on the analysis of disease causing risk factors, we can discover subtle differences that cannot be found in small samples and provide scientific evidence for personalized treatment.**
- **Based on the analysis of different characteristics of health files and electronic medical records, proactively recommend personalized prevention and health care knowledge.**

Method (2) - Proactive Services

Mobile Services

- ✓ Doctors: provide treatment basis and guidelines, norms
- ✓ Children: personalized treatment solutions
- ✓ Parents: autism diagnosis and treatment solutions and prevention knowledge
- ✓ Government departments: visual data analysis and early warning

Systems Integration

Intelligent monitoring

- ✓ Intelligently discover high-risk children with pathogenic characteristics through data analysis

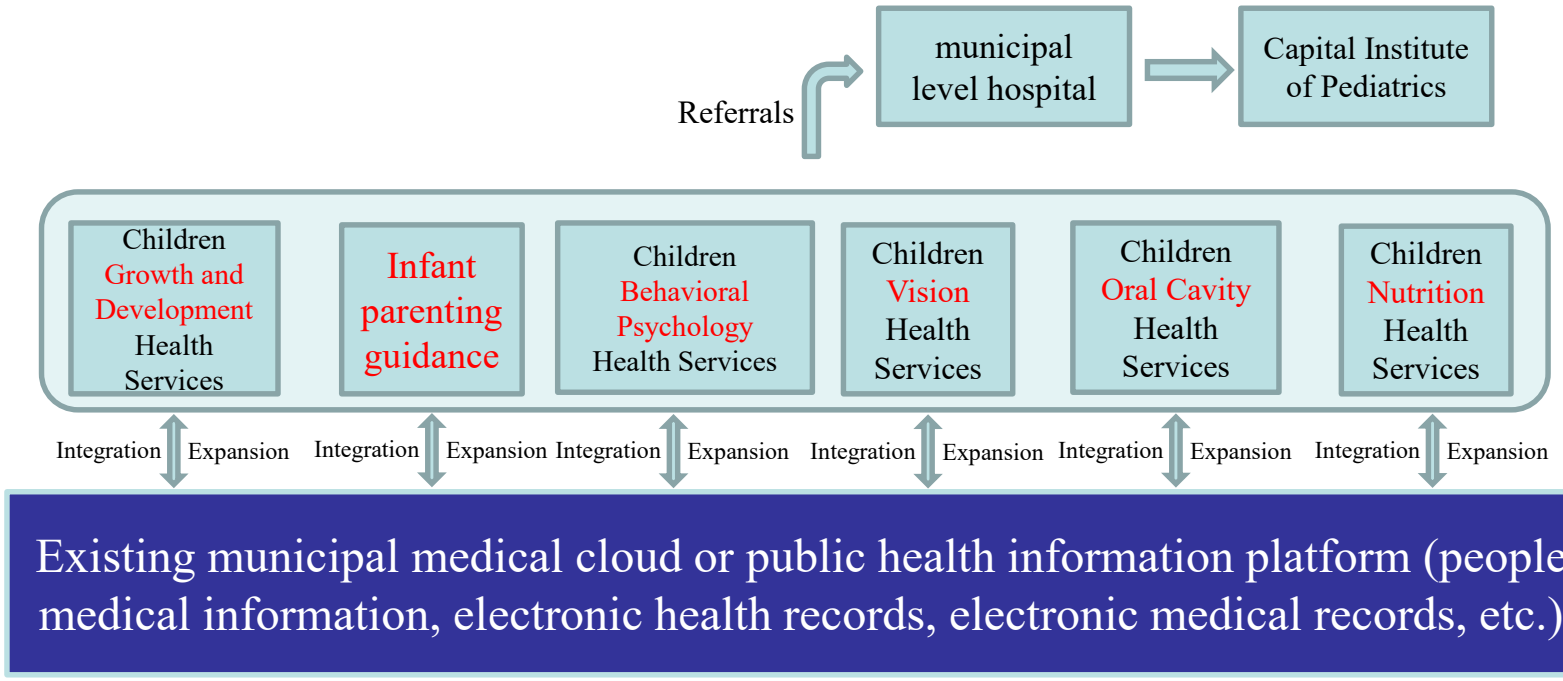
Database

Automatic acquisition

- ✓ Interface with Hospital Information System (HIS): continuous and dynamic import of health and treatment data for children of school age and pregnant women
- ✓ Autism diagnosis and treatment guidelines and norms
- ✓ APP collects crowdfunding data and knowledge

Children's Health Service Platform

Expand the existing municipal medical cloud or public health information platform.



Implementations

service items

Growing development, oral, nutrition, vision prevention and control, psycho-behavioral development assessment, etc.

Community Service Center

Local medical institutions

Local Primary Services

implement

support

Capital Institute of Pediatrics

Service business support platform

Management

Child growth and development	Psychological Behavior	Children's oral cavity	Child Nutrition
Newborn Management	Infant and toddler parenting guidance	Vision prevention and control	

Mobile

Self-service	Smart Reminder	Doctor-patient communication	Disease Alert
Medication guidance	Self-assessment	Tests and examinations	Wearable devices

Basic information technology support platform

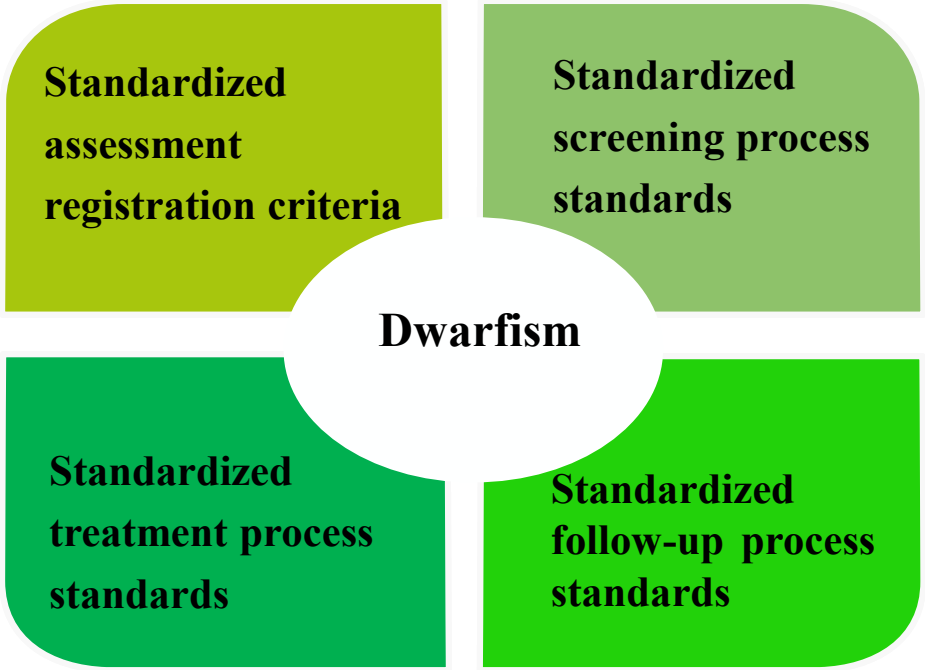
Grassroots institutional capacity building

- Specialized records database
- Home Smart Call Terminal

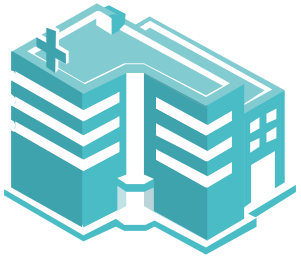
Regional shared resource building

- Regional Health Information platform interface
- Regional Hospital Interface

Case 1: Aided Decision Making for Growth and Development Health Services



In-hospital Services and Specialty Medical Health Services Linkage Model



In-hospital information systems

- Health record data sharing
- Push for children below the growth dwarf curve
- **Fine management of the screening process**
- Follow up data interconnection
- Referrals, consultation needs

Dwarfism Screening and Intervention System

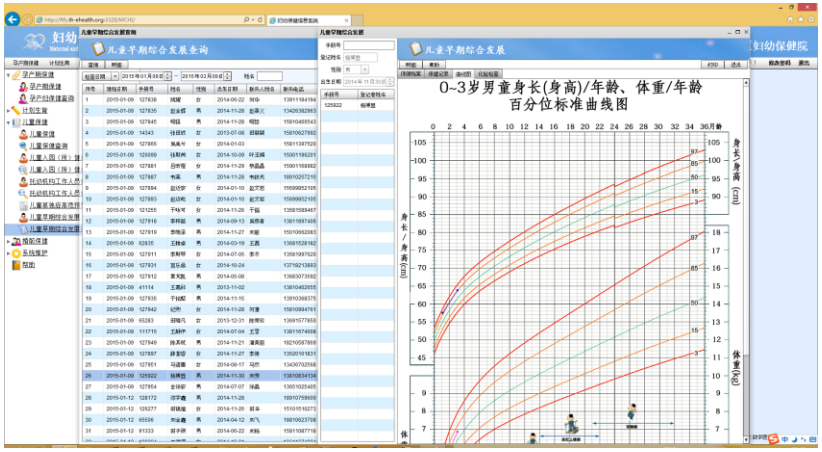
app specialist doctor assistant

Cloud service platform

Standardization
Normalization
Specialization
Systematization

Through integration with the in-hospital system, children below the growth dwarf curve in the physical examination are pushed to the specialist based on the health record data and proactively reminded for further standardized screening.

Intelligent Integration with In-Hospital Systems



Through the integration with the child growth and development monitoring system or child health care system, the automatic screening module automatically detects people of the same age and gender suspected of being short and pushes them to the active screening alert system.

Standardized Screening and Diagnosis System for Children with Dwarfism - Screening and Diagnostic Clinic Management

Mobile platform-based standardized screening and diagnosis system, screening and diagnosis outpatient management:

- Outpatient management.
- Schedule management.
- Follow-up consultation management.
- Medical record management.
- Teleconsultation.
- Referral requests.
- Clinical guidelines and knowledge base.

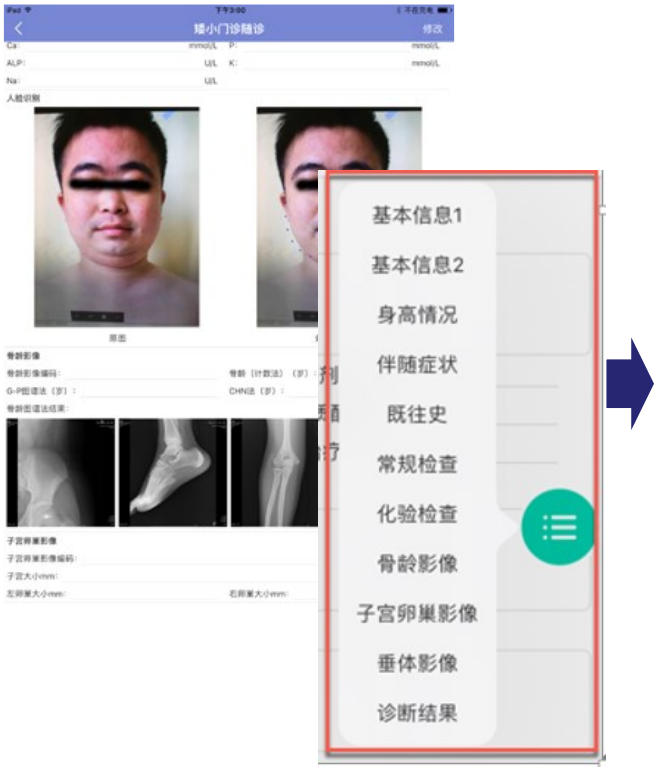
Standardized Screening and Diagnosis System for Children with Dwarfism - Standardized treatment (1)

Initial diagnosis:

The patient's growth and development profile is established and the initial examination is performed according to standardized criteria:

- Basic information.
- Physical examination.
- Past history.
- Family information.
- Routine examinations.

Standardized Screening and Diagnosis System for Children with Dwarfism - Standardized treatment (2)



Standardized examination tests:
For suspected patients, further screening primary examinations are performed in accordance with the standardized clinical pathway:

- The Multi-item laboratory tests.
- Bone age imaging.
- Utero-ovarian imaging.
- Pituitary imaging.
- Necessary chromosomal and genetic examinations.
- Morphological examination of the external appearance of the form.

Standardized Screening and Diagnosis System for Children with Dwarfism - Standardized treatment (3)

常用 GH 缺乏筛查试验

筛查试验	方法	峰值	备注
运动试验	中等至剧烈活动 20 分钟，运动后 20~40 分钟空腹取血	运动后 20~40 分钟	70%正常人 GH 分值>10ug/l
睡眠试验	患儿入睡 2 小时内，20 分钟取血一次，共 6 次	40~100 分钟	

常用 GH 缺乏确诊试验

筛查试验	方法	出现 GH 高峰时间	备注
可乐定	用量：0.15mg/m², 口服，服药后 60,75,90 分钟取血。服药前取一次血作基值	60~90 分钟	可乐定服后可引起疲倦、入睡、少数可恶心、呕吐
L-多巴	用量 0.15g/1.73m²，或 10mg/kg，服用前后 30,60,75,90 取血	60~90 分钟	可引起恶心、呕吐，多在 1 小时内消失
精氨酸	10%精氨酸溶液按 0.5g/kg，静脉滴注，30,60,90,120 取血	60~90 分钟	此药无特殊副作用
胰岛素	用量：正规胰岛素 0.075U/kg，静脉，注射后 15，30,45,60,90,120 分钟取血	45~90 分钟	注射前后测血糖，血糖<40mg/dl 或较基值下降一半为有效刺激。注射前后 60 分钟取血测定皮质醇

Standardized clinical trials:

- Trial preparation.
- Trial prohibition reminders.
- Documentation of trial steps.
- Analysis of trial results.

External Support - Integrated with Third Party Laboratory Testing

检查项目	目的
血常规	轻度贫血以及营养不良
血肌酐	肾功能衰竭
尿素氮	肾小管酸中毒
血钙磷	证实有无假性甲状旁腺功能减退或维生素D抵抗佝偻病
甲状腺功能	有无亚临床甲状腺功能低减
血类胰岛素样生长因子-1（IGF-1）	筛除GHD
染色体检查	有无Turner综合征，21－三体综合征，18－三体综合征，13－三体综合征
血IGF BP -3	辅助IGF-1检查
POUIFI基因	基因排除
(Pit-1)基因	基因排除
PROP-1基因	基因排除
GHRH基因	基因排除
GHRH受体基因	基因排除
GH-N基因	基因排除
GH受体基因	基因排除
IGF-1基因	基因排除
IGF-1受体基因	基因排除
SHOX（PHOG）基因	基因排除
微量元素	辅助检查
过敏源	辅助检查

Comprehensive analysis of laboratory tests, based on the results, gives an interpretation of the significance of the auxiliary judgments:

- Routine examinations.
- Growth hormones.
- Chromosome examination.
- Genetic tests.
- Trace elements.

Provide integrated services of third-party testing for projects that cannot be carried out in the hospital at present.

Case 2: Research on Diagnosis System for Children's Developmental Coordination Disorder

Developmental coordination disorder(DCD)

- Definition: a neurodevelopmental disorder.
- Symptoms: impairment of motor skills, coordination ability, restriction of daily movements.
- The incidence is currently at 5%, concurrent ADHD (hyperactivity disorder), and it is easily overlooked.
- The cause of the disease is currently unknown, and is detected at the age of 5-6 years, with young children exhibiting age-appropriate motor skill deficits.

What are the current effective treatments?

- Early detection and early intervention
- Movement training

Diagnostic tools

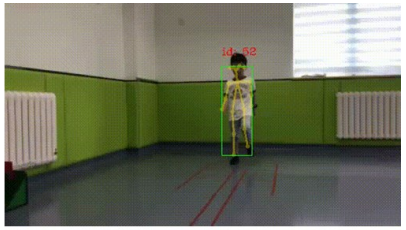
- Specialized physicians (pediatricians, behavioral developmental pediatricians, pediatric neurologists, child psychiatrists)
- Assessing children's motor skills in the following areas: strength, balance, coordination, range of motion, motor planning, and fine movements control
- Various scoring scales: MABC-II、DCDQ、PDMS-II、BSID-II、DIAL-R
- The scale is a comprehensive assessment of the child's quality of movement completion, and the diagnosis is based on the scale records and the physician's experience

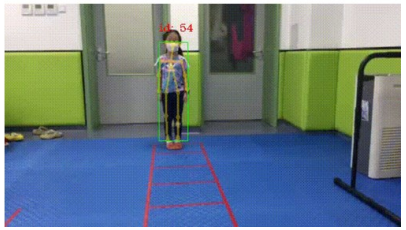
Beijing Children's Hospital (partner) assessment scoring scale

- Localized modification based on MABC-II
- **18 kinds of movements**: coin tossing, bead stringing, 1.8m sandbag catching, 1.8m spot throwing, standing on one foot with eyes open, heel walking in a straight line, continuous jumping on both feet, stepping in place, pointing, standing on one foot with eyes closed, primary open and close jumping, intermediate open and close jump, advanced open and close jumping, single foot jumping, pony jumping, heel walking in a straight line, double foot jumping, holding a pen.

Movement Evaluations

- Static fine movements
  - Coin tossing (dominant hand, non-dominant hand)
  - Beads stringing
  - Drawing lines within boundaries
- Static movement action
  - One-legged stance (dominant leg, non-dominant leg)
  - Primary open and close jumping
  - Intermediate open and close jumping
  - Advanced open and close jumping
- Dynamic movement action
  - Two-handed sandbag catching (10 times)
  - Sandbag throwing with one hand (10 times)
  - Walking on tiptoe
  - Double-legged jumping lattice
  - Standing Long Jump

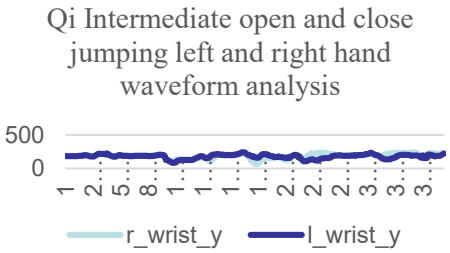


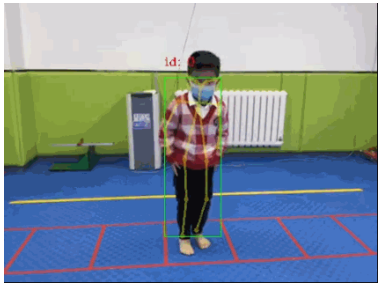


The current research phase focuses on the assessment effects of the static motor action component.

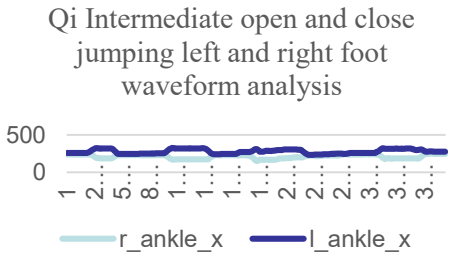
Research Situation - Basic Waveform Analysis of Open and Close Jumping

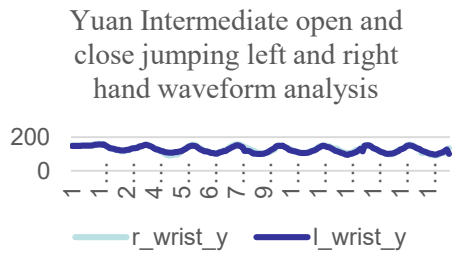
Left and right hand waveform curve

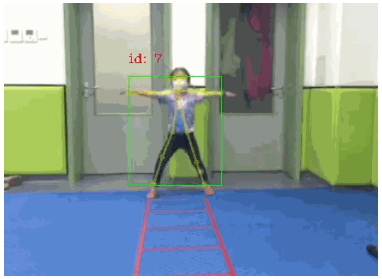


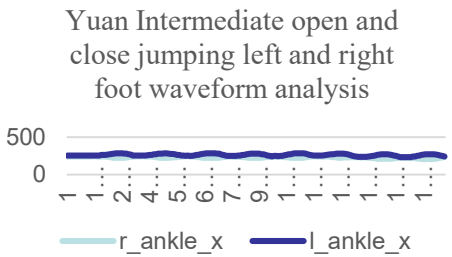


Left and right foot waveform curve









After processing the original bone point data, the data can be used for preliminary waveform analysis to judge the characteristics of periodicity and stability.

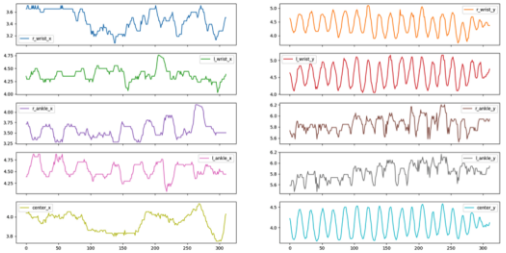
Research Situation - Waveform Analysis Sample

儿童运动模式分析

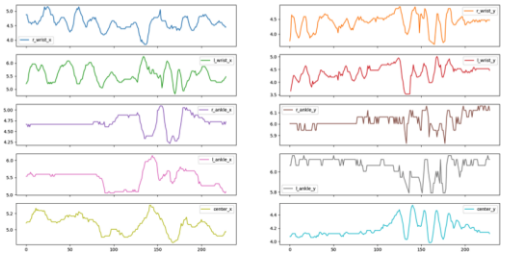
mabc评分相同运动模式分析

- 下示所有图样的横坐标为时间，纵坐标为距离，均已经过异常值处理、滤波、归一化操作，x坐标为横向，y坐标为纵向

沈惊萱&沈怿安

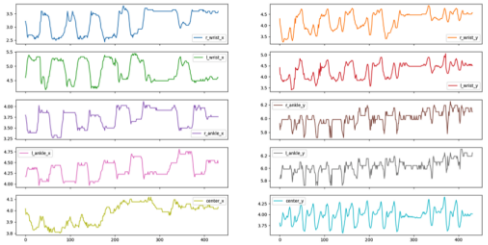


- 以上为沈惊萱的初级开合跳左右腕、左右脚踝以及中心点的运动波形图，左侧为x坐标右侧为y坐标，对于初级开合跳动作模式关注重点在于踝部的x坐标变化，从波形分析的动作模式看，沈惊萱的开合跳运动模式具有有一定规律性，但动作幅度表现不均



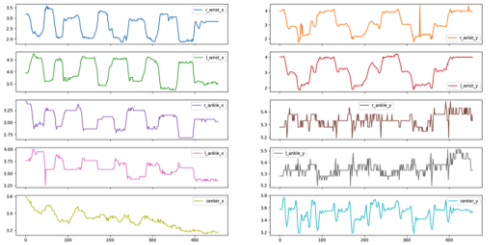
- 以上为沈怿安的中级开合跳左右腕、左右脚踝以及中心点的运动波形图，关注重点在与踝部x坐标变化，可以发现其运动并无明显周期，不符合正常开合跳体现的波形规律，且动作幅度变化异常

路小宸



- 以上为路小宸的中级开合跳左右腕、左右脚踝以及中心点的运动波形图，关注左右脚踝x坐标变化以及左右腕关节y坐标变化，可以看出其运动存在周期性，且幅度均匀性较好

杨诗墨&王佳怡

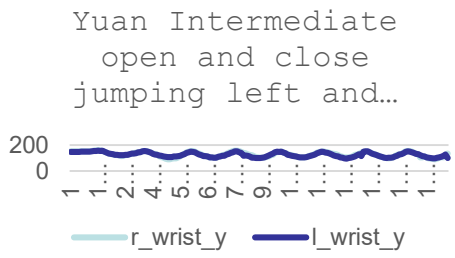


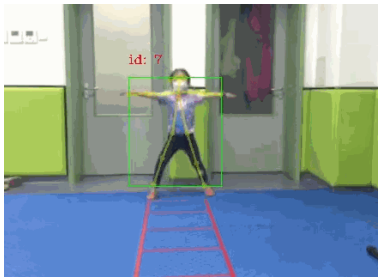
- 以上为杨诗墨的高级开合跳左右腕、左右脚踝以及中心点的运动波形图，高级开合跳关注重点是踝部x坐标变化以及腕部y坐标变化，从上图可以发现，脚步动作结合中心偏移观察有稳定的周期性，腕部动作符合高级开合跳的阶段停顿特征

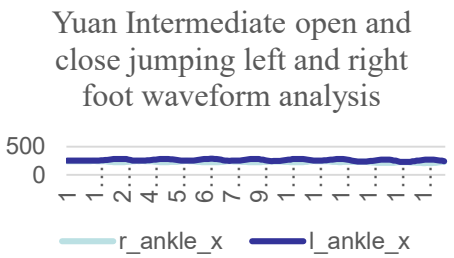
Research Content - Preset Rules for Movement Evaluation

- Using the skeletal point data obtained from the analysis, each action is scored according to the set rules, such as the angle of the legs of the open and closed jump, the angle of the trunk of the hand, the relative position of the hand and the head, etc. In accordance with the established rules for scoring, the score results are weighted and summed, the score range becomes 0-100, and the threshold value set for judging the non-conformity of the action is set at 80 points.

Research Content - Use the Normal Mode to Compare the Similarity for Movement Evaluation







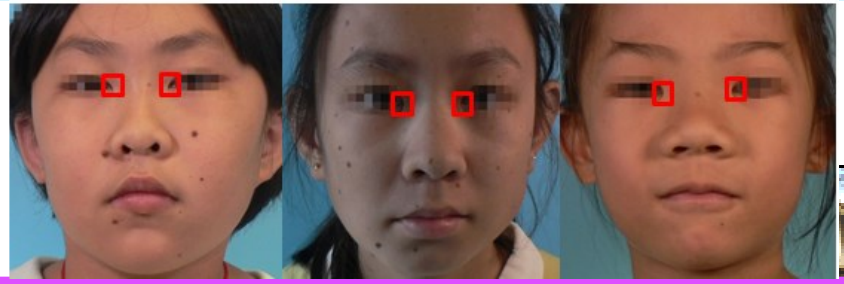
- The above samples are the samples of healthy children used in the test. The action norm of healthy children is collected according to the healthy samples, and the similarity calculation is used to evaluate the action quality.

- Scoring method: scoring is mainly based on the time series similarity of feature points. There are 18 feature points in total. Each feature point has a position sequence in the time dimension, with X-axis position and y-axis position respectively. For a single person, there is an 18 * 2 time series. After DTW alignment with the time series corresponding to the action template, the Euclidean distance mean value is calculated. There are 18 * 2 Euclidean distance means in total. Compare the 18 * 2 Euclidean distance means with the corresponding setting threshold (there are 18 * 2 in total, and the appropriate corresponding threshold needs to be found out by experiment). If it exceeds the corresponding threshold, 0 point will be counted, and 1 point will be counted within the range of the corresponding threshold. Then, the 18 * 2 scores will be weighted and summed (the weight is determined according to the experimental situation, so that the final score range can be 0-100 points). Finally get the score.

Case 3: Face Recognition based on Machine Learning

Turner syndrome face-assisted diagnosis system

Turner syndrome is a chromosomal abnormality that can cause dwarfism and occurs only in females. Due to chromosomal abnormalities, the patient's face has some unusual features.
Using standardized acquired face images of Turner syndrome patients, we established a Turner syndrome face-assisted diagnosis system through face image preprocessing, feature extraction, classification prediction, performance evaluation, and result presentation steps.



Adenoid abnormalities face-assisted diagnosis system

Adenoids are also called pharyngeal tonsils or proliferating bodies. Abnormal adenoids are mainly manifested as adenoid hypertrophy. The cause is that the adenoids develop pathological hyperplasia due to repeated stimulation of inflammation, which causes the symptoms of nasal blockage and mouth breathing and leads to the formation of "adenoid face ".

1 **Facial morphology image acquisition has become a standardized step in the dwarf clinic of Union Medical College Hospital.**

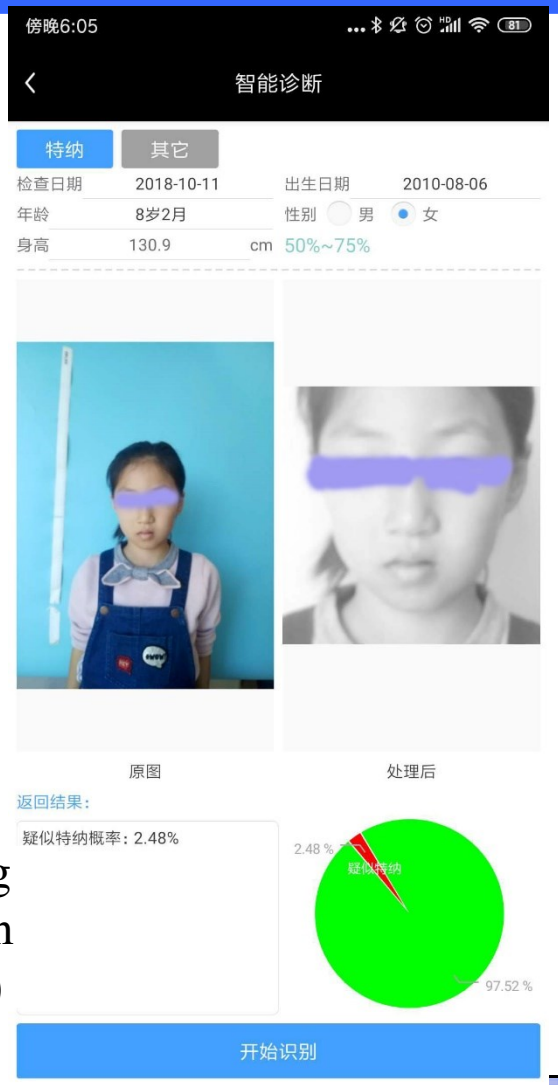
Every child who goes to the dwarf clinic of Union Medical College Hospital needs to take facial morphological images first.

2 **Outpatient Data Collection**

- Image examples (as of 2018.9.30): **3687**.
- Including: Turner syndrome (TS), Growth Hormone Deficiency (GHD), Partial Growth Hormone Deficiency (PGHD), Small for Gestational Age (SGA), Idiopathic Short Stature (ISS) and other diseases such as healthy controls Image examples.
- Acquisition environment: Acquisition room.
- Requirements of the photographed person: fixed posture, put away bangs, natural expression, etc.

3 Developed a special face image acquisition equipment, and established face images and patient information database.

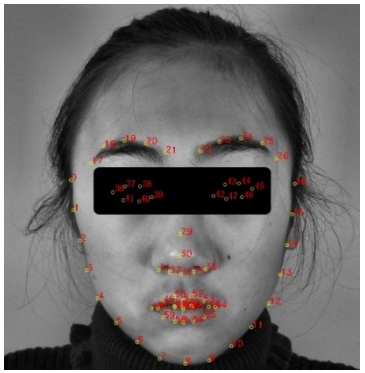
Aided screening system(based on Facial features)

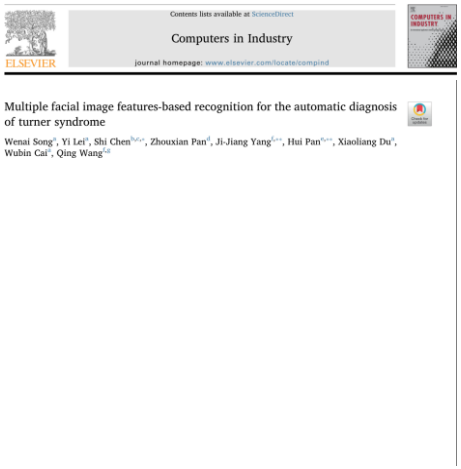


Result

面部区域	患者	健康人	提取方法
前额	宽大	正常	距离计算
眼距	**宽大**	**正常**	**比例计算**
内眦赘皮	有	无	Gabor 变换
鼻梁	**高**	**正常**	**距离计算**
面部黑痣	较多，较大	正常范围	斑点检测

分类类别与方法					
局部特征					
前额	**0**	**1**	**0**	**0**	**1**
眼距	1	1	1	1	1
内眦赘皮	**0**	**0**	**1**	**0**	**1**
鼻梁	0	0	0	1	1
面部黑痣	**1**	**1**	**1**	**1**	**1**
样本数（正样本/负样本）	23/52	23/52	23/52	23/52	23/52
平均准确率（%）	**81.5**	**80.0**	**80.0**	**83.0**	**84.6**

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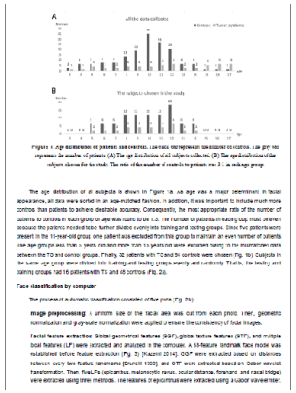
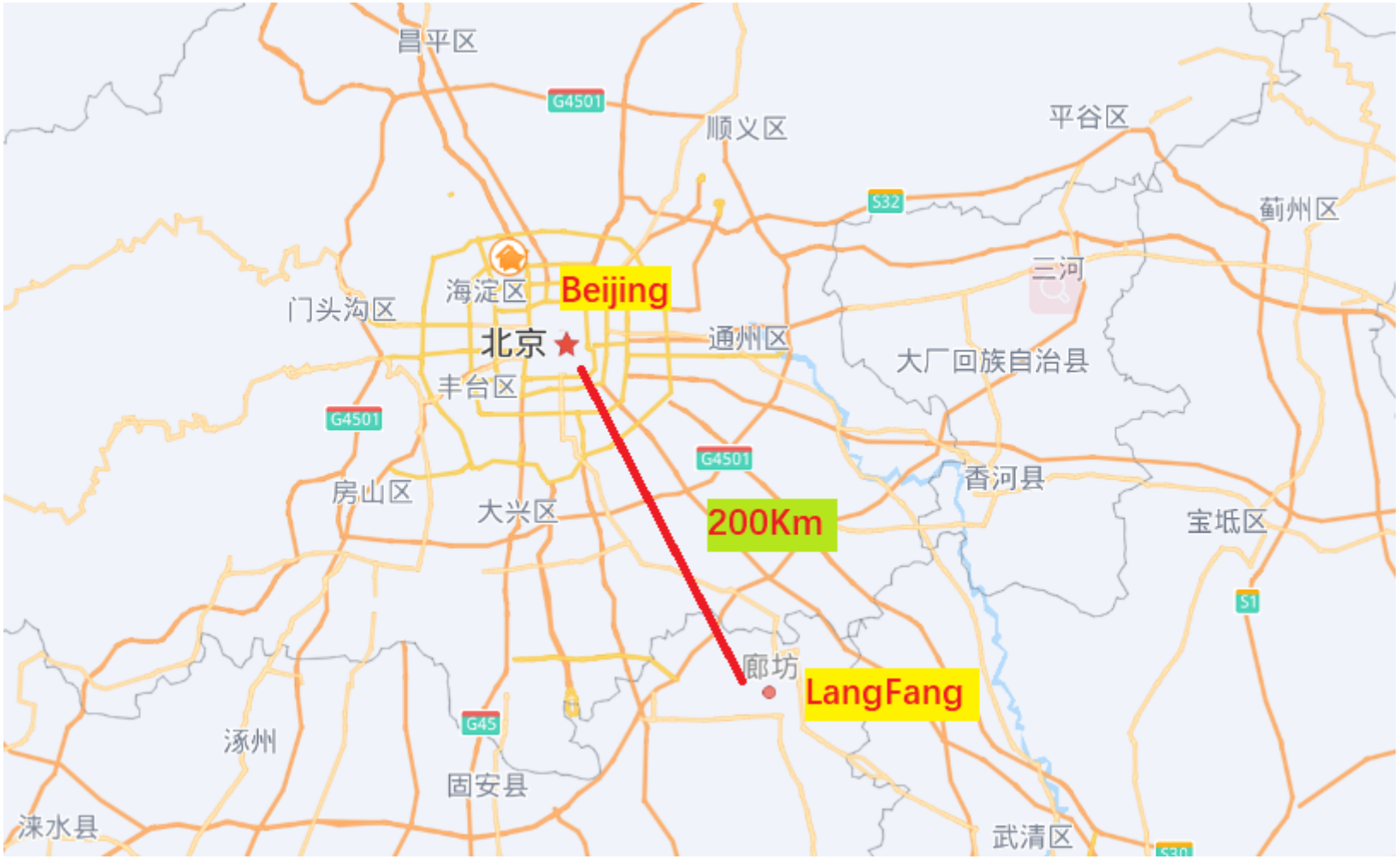
Multiple facial image features-based recognition for the automatic diagnosis of turner syndrome

Wenai Song[a], Yi Lei[a], Shi Chen[b,c,*], Zhouxian Pan[d], Ji-Jiang Yang[c,e,*], Hui Pan[b,c,*], Xiaoliang Du[a], Wubin Cai[f], Qing Wang[f,g]

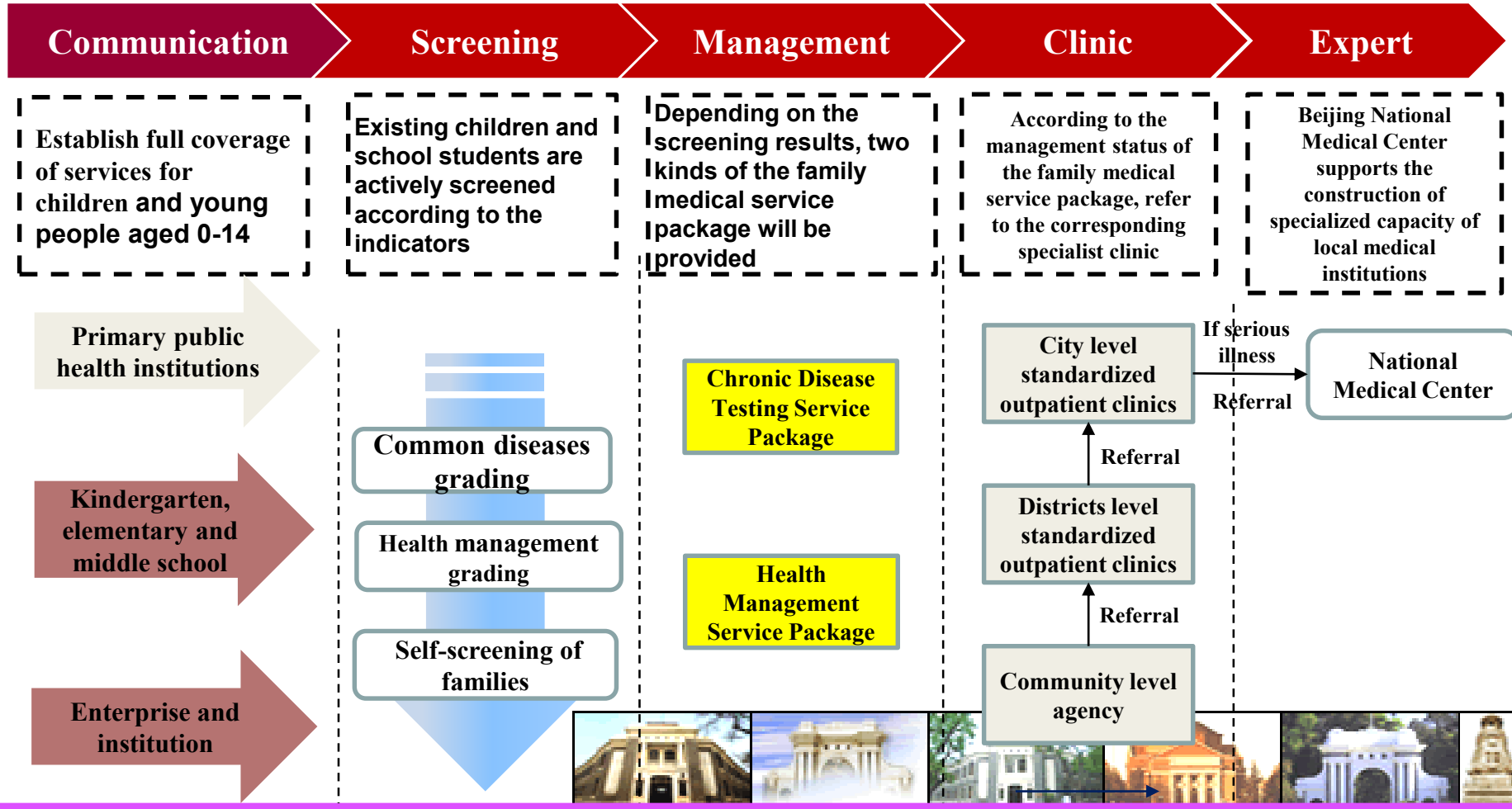


Practice in LangFang



Practice in LangFang

The prominent health problems of children and adolescents are concentrated ("eating, moving, and sleeping"), while screening, intervention, and treatment can be realized through the system and processes.



Data-Driven Child Health Management --Opportunities and Challenges

In infancy, for children in intensive care, big data can be used to better integrate and analyze massive amounts of data and monitor the child's disease problems in real time.

In the growth of children, it is possible to use wearable devices suitable for children to wear to monitor various physiological data of children in real time, thus avoiding the occurrence of diseases and dangers.

In the area of children's psychological problems, big data technology can be used to analyze children's mental health problems to achieve rapid statistics, timely feedback and intervention to promote children's healthy psychological growth. Big data can also be used to prevent and treat children's mental illnesses.

In terms of children's physical health, for children who lack exercise, big data technology can be used to establish a set of exercise information analysis platform, thus helping to prompt children to exercise.

For children's disease prevention and treatment, a Big Data-optimized medical decision-making program can be established. Or use big data for personalized medicine to better target children's treatment.

谢谢大家！ Thanks for your attentions!

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