Research on Respiratory Medical IoT(MioT)

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Medical Care Needs MioT

- Uneven distribution of medical recourse, need for tiered diagnosis and treatment
- Homestay community require management of chronic disease
- Need 4P medicine and intelligent medicine
- Local medical device request for the international market

100 M COPD

30 M Asthma

OSAS 30 M

Pulmonary Nodule 120 M

+2 M Death caused by respiratory failure, lung cancer

Respiratory infectious disease ~1 M

Inefficiency on medical resource application

++ require management of chronic disease

Low quality of healthcare quality

--coverage of chronic disease management

Low efficiency medical system

Community Hospital "Three Low"

Hard to be admitted in famous hospitals
Hard to see famous doctors

Chin J Tubere Respir Dis; 2013；36（4）：255-264.
Chin J Tubere Respir Dis; 2016；39（9）：675-697.

IoT Medical Theory Research

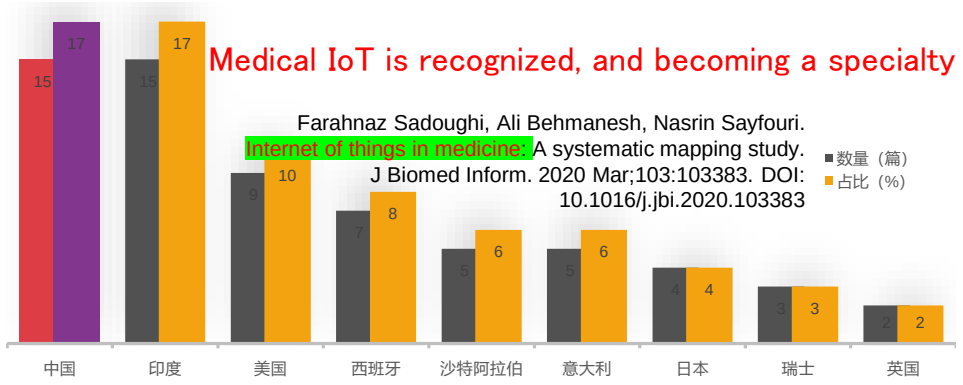
The Concept of MioT

- In 2008, Prof. Chunxue Bai invented cellphone based wireless spirometry, which was reported by ‘Who’s who’ column in 2009 ATS NEWS | VOL.35 NO.7/8
- Then, he proposed ‘Medical Internet of Things(MioT)’ and edited the books of *Practical Medicine with of IoT*, *Hierarchical Diagnosis and Treatment by Medical IoT, Medical Internet of Things,* and co-edited *e-Health 4.0:How Virtualization and Big Data are Revolutionizing Healthcare* with Prof. Thuemmler

Modern Concept of MioT

- By the internet connection of physical things network, including hardware and software technique of sensing, transferring and intelligent processing, it could combined virtual reality (information) and real world (object) to service the huge market of healthcare

- Sadoughi et al. recently published a medical IoT related research, they searched out scientific database from 2000 to 2018 (including IEEE Xplore, Web of Science, Scopus and PubMed) to find 89 papers fitting the concept of medical IoT. Among them, **the highest published countries were China, India and US**
- **Meantime, they also find it is urgent to define the word of 'IoT in Medicine'**
- **This suggests Medical IoT is becoming a specialty**



Biomed Inform, 2020, 103:103383

Advance in Clinical Application of MioT

Clinical Research and Application in China

- **AI assist early detection of lung cancer：The system was used in 900+ pulmonary nodule centers**
- **AI assist management COPD and asthma : Developing the early detection and management systems by using clinical informatics, including CT and lung function testing**
- **nCapp fighting against COVID-19:** Recommended by ATS to detect virus pneumonia and other infectious disease. It could also evaluate the progression and staging of the pneumonia

Int J Respir, 2017, 37(8):561-568; Int J Respir, 2021,41:321-323.
I J COPD 2014:9 381–395; AJRCCM 2020, 201:1019–1022; Eur Res Rev 0287-2020.

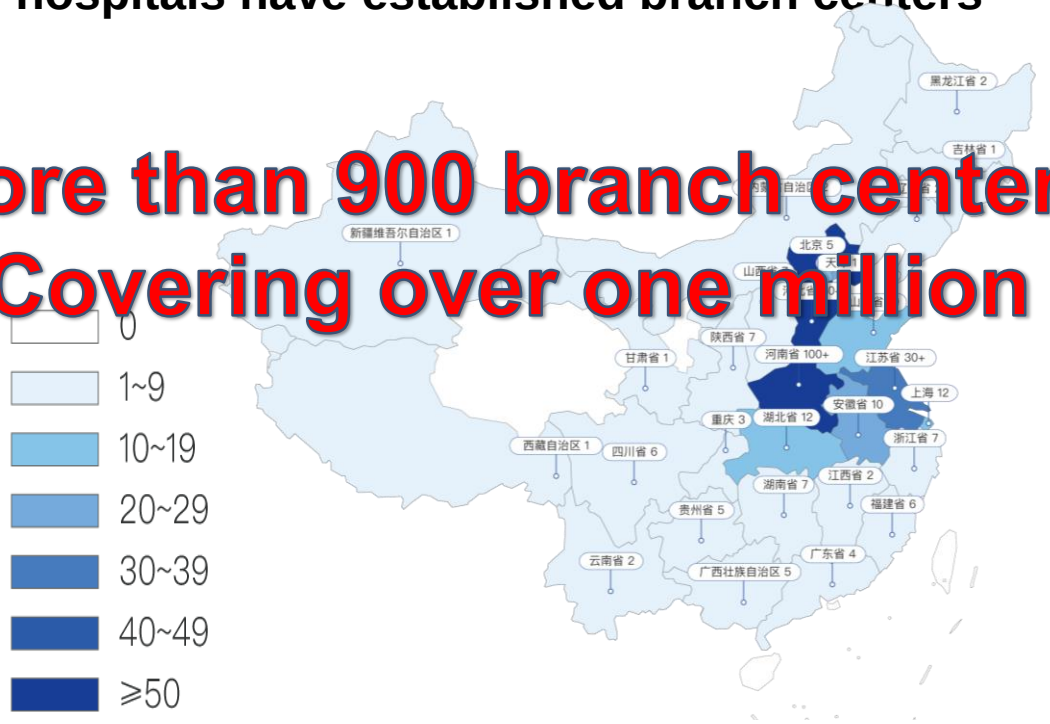
900 Application Sub-Centers Have Been Launched Nationwide

Establish more than 20 medical IoT sub-centers to carry out IoT medical care

Academician Zhong Nanshan highly affirmed the Medical IoT work of Professor Bai Chunxue's team at the 2019 National Respiratory Medicine Annual Conference

More than 120 university hospitals, including Zhongshan, West China, First Hospital of Guangzhou Medical University, Peking Union Medical University, Wuhan Tongji, etc., and more than 780 prefectural and county-level hospitals have established branch centers

More than 900 branch centers
Covering over one million



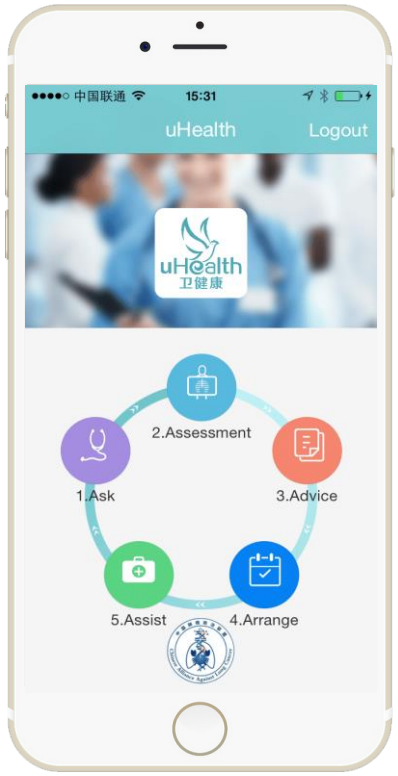
AI Assisted Early Detection of Lung Cancer

- Developed the new concept of IoT in medicine
- **Launching the ”Expert-Machine MDT" for outpatient clinic in Jan 2019,** combining AI to offer patients comprehensive evaluation and management with the sensitivity of 99%, and the specificity 98% for early stage of lung cancer

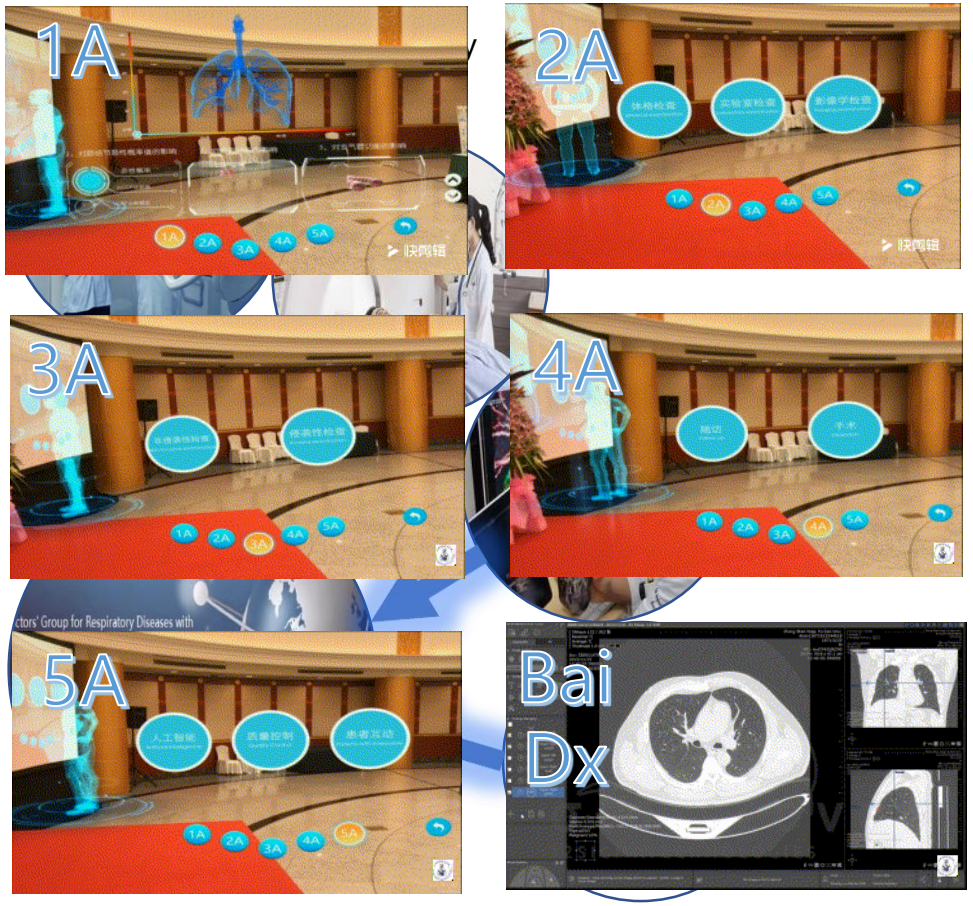
Chin J Tuberc Respir Dis, 2018,41(10):763-771
Int J Respir, 2017, 37(8):561-568; Int J Respir, 2021, 41：321-323

Integrate Consensus Guidelines into PNapp 5A

Easily upgrade the handicraft workshop mode to the homogeneous level



1A	• ASK: history of exposure to risk factors, medical history and family history of tumors, COPD, pulmonary nodules, etc.
2A	• Assessment: chest CT, LCBP and AI, and differential diagnosis of tuberculosis and fungus
3A	• Advice: Individualized liquid biopsy, ask Grade A, B or C-level experts to judge those who are difficult to diagnose
4A	• Arrangement: those with a clear diagnosis will be given corresponding treatment, and those with high malignancy will be evaluated by Grade A&B experts and a diagnosis and treatment plan will be provided.
5A	• Assistance: IoT-assisted quality control, consultation, and post-operative management



simplification of complex problems, **digitization** of simple problems, **proceduralization** of digital problems, and **systemization** of procedural problems

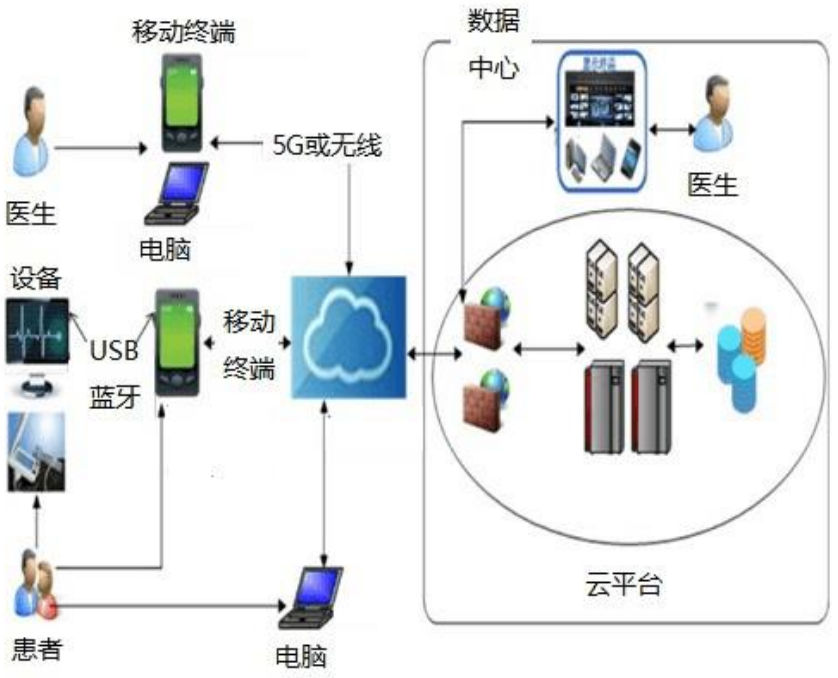
Integrate PNapp5A into Two Step Process

1. Scan the code; 2. Connect with IAIH cloud; 3. Generate LCBP and analyze with AI; 4. Junior experts make primary evaluation; 5. If lung nodules ≥ 10mm are indeterminate, invite experienced experts to reevaluate

Patent: mobile phone cloud plus terminal MIoT system

PNapp 5A

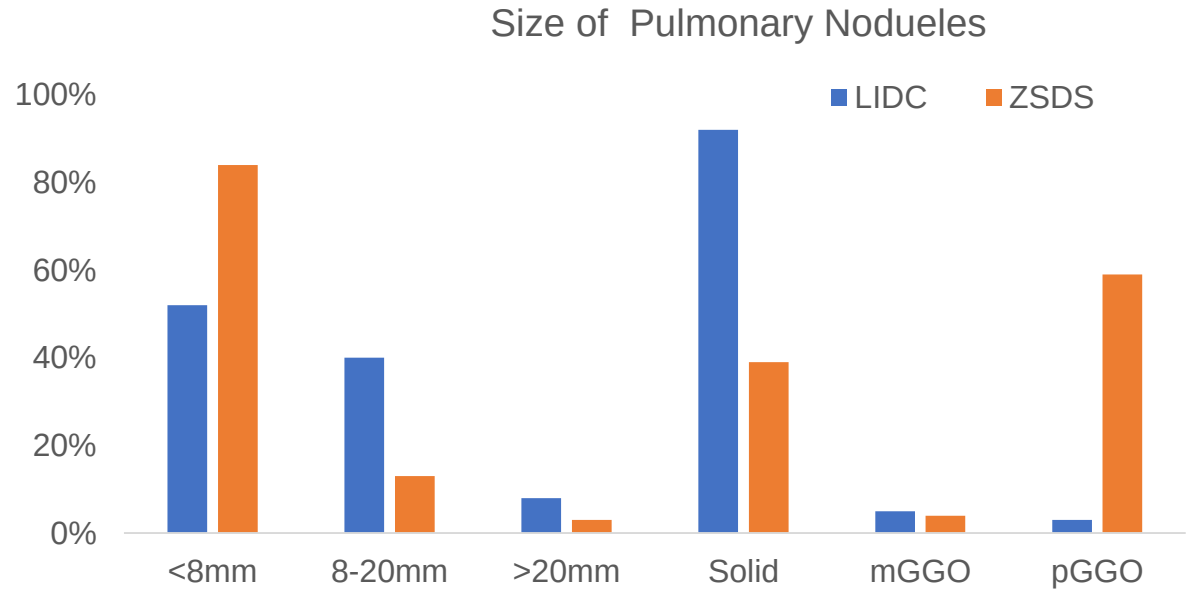
cloud plus terminal implements homogeneous diagnosis and treatment



The Difference of Early Detection of Lung Cancer with and without MioT

- From 2014 to 2019, 16,417 cases of pulmonary nodules were operated at Zhongshan and 9,980 cases with early stage of lung cancer (60.8%) were rescued
- The average age dropped from 63 in 2014 to 50 in 2019
- **Reasons for the success of the case:**
  - Screening the people with risk factors ≥ 40 years old
  - Serve the Patients with PNapp5 A
  - Junior experts make primary evaluation
  - If pulmonary nodules ≥ 10mm were indeterminate, I will be invited for reevaluation

Int J Respir 2021, 41:321-324



Compared with the data from the Lung Nodule Clinical Imaging Database (LIDC) in the NLST study in the United States, the proportion of patients with malignant pulmonary nodules that were surgically removed in Zhongshan Hospital was significantly higher than that of patients with lung nodules in the pre-infiltration stage

Note: The above data sets of the United States and China are based on the case data analysis of the LIDC database and the Zhongshan Hospital database respectively

Research Center on Respiratory Medical IoT Engineering

Incorporate new concept of MioT into Clinical Practice

Improve homogeneity

Reduce delays in diagnosis

Reduce over treatment

Reduce cross-infection caused by offline work

Artificial intelligence

Network construction

Resource Integration

Big data processing

Medical experts

Sensor

Pulmonary nodules

Chronic obstructive pulmonary disease

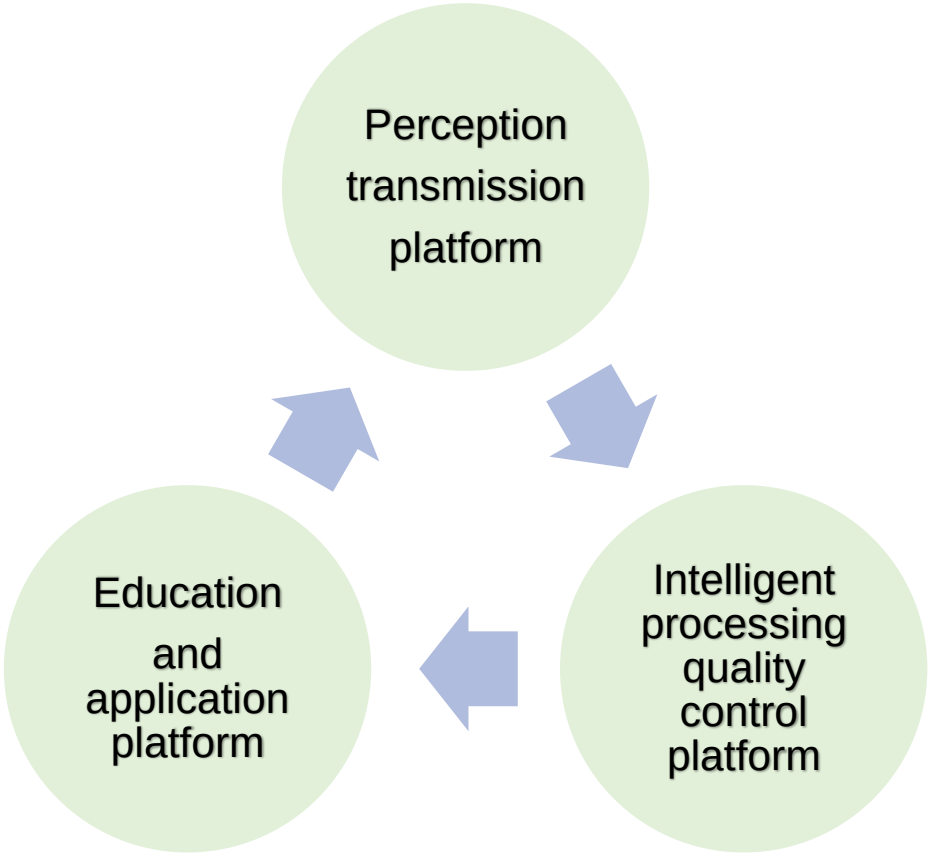
Acute respiratory infections

The Goals and Tasks of the Center

Establish a four-features engineering center with "culture, talents, technology, and social benefits"

Top Design	Start with the focus on the research and development of **common diseases** such as lung cancer, chronic obstructive pulmonary disease and viral pneumonia, then expand others
Scientific Innovation	Focus on the development of related products for the **early diagnosis** and follow-up **management** of the above-mentioned diseases
Academic Leading	Develop guidelines and consensus related to MIoT, and improve quality control to improve the level of **homogenization** of medical care
Clinical translational	The focus is on the center to make the products realize the vision of "famous doctors cure diseases, **great doctors benefit all living beings**"

Create three IoT medical platforms



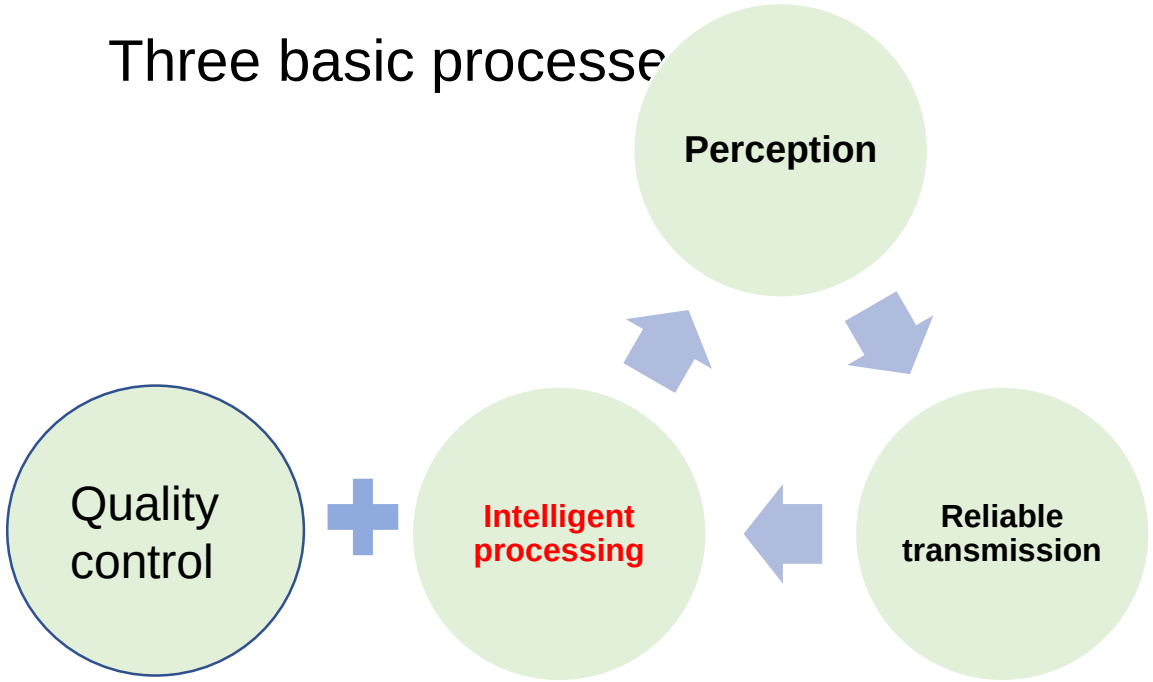
Sensing and Transmission Platform

Simplification of complex problems, digitization of simple problems, proceduralization of digital problems, and systemization of procedural problems

The goal of building

Build an internationally advanced Platform for MioT

Three basic processe



Main mission

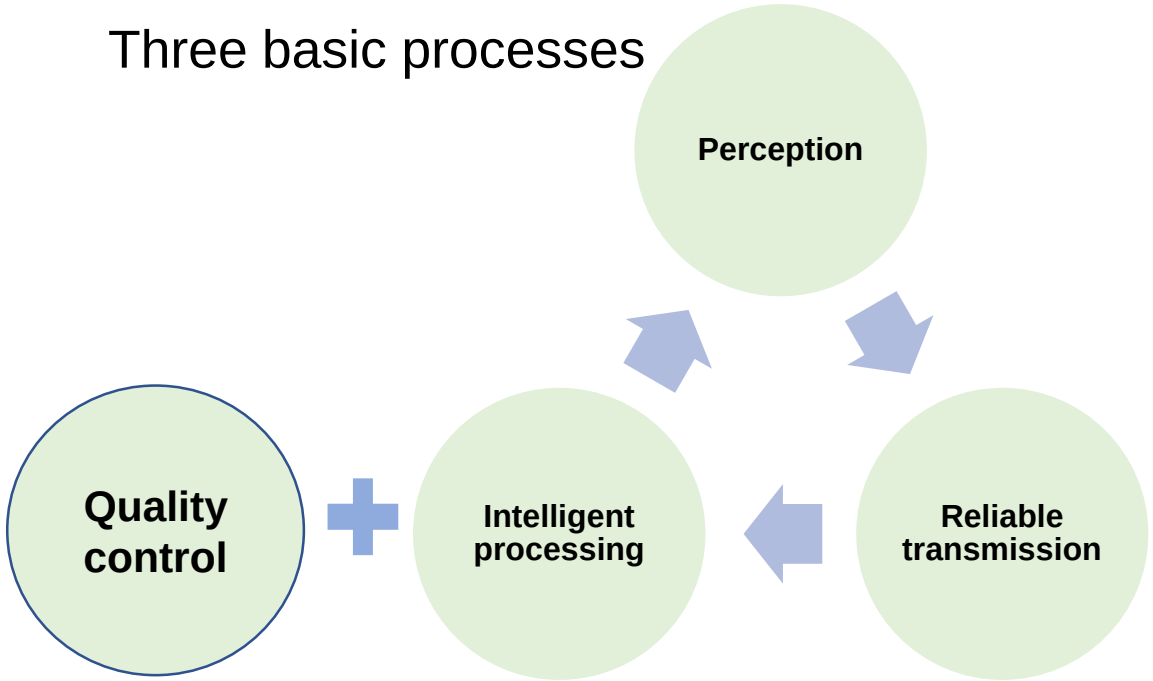
Perception	• Take the IoT pulmonary function instruments as breakthrough points to build an internationally advanced level of **respiratory function sensing** equipment
Perception	• Developed a wearable **cardiopulmonary coupling monitoring system** to monitoring chest breathing, abdominal breathing, breath sounds and diaphragm movements, with a battery life of no less than 48 hours
Perception	• Develop a wearable **exercise lung function** monitoring system to reliable monitoring of nasal airflow and composition, vital capacity, tidal volume, carbon dioxide concentration and oxygen concentration
Transmission	• Using the chip as the starting point, build an internationally advanced **transmission software and hardware equipment** that can break the current information island effect

Intelligent Processing and Quality Control

The goal of building

Build an internationally advanced Platform for MioT

Three basic processes



Main mission

Chronic respiratory disease and health management system

Early detection and risk prediction model based on multi-modality

Viral pneumonia and lung nodules "Intelligent Processing"

Reach the international leading level

Education and Promotion Application Platform

The goal of building

- Serving 120 million users for Healthy China “2030” plan through platforms “Healthy China Internet TV”

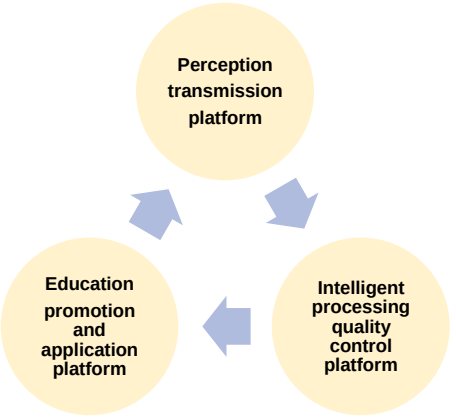
Main mission

·"Healthy China Internet TV" channel

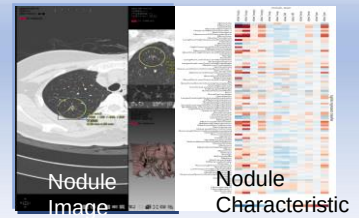
- Smart health and medical work
- Lung nodule diagnosis and treatment and big health IoT experience center
- **IHC** online version and mobile version
- Integration and command of IoT management functions
- Serve **120 million** users and radiate grassroots physicians

Upgraded OTT all-in-one machine

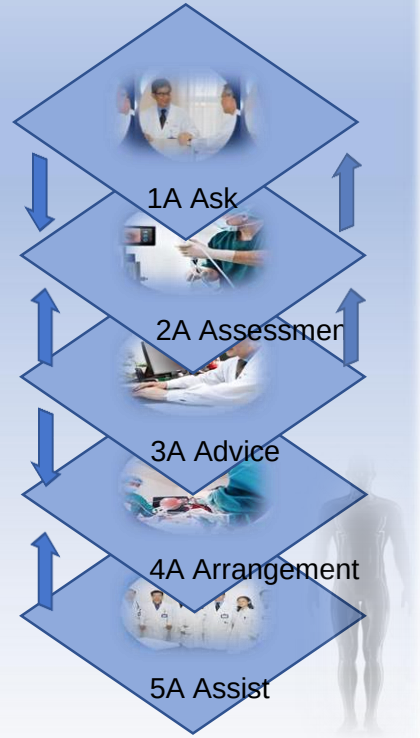
- Improve promotion effect



Application Area 1: Early Detection of Lung Cancer
Reducing Lung Cancer Mortality and Increase 10-year Survival Rate



Radiological reductionism



Integrate consensus guidelines and technology into the 5A process, and use AR to assist in promotion

To innovate and develop software and hardware for early detection of lung cancer

- To innovate and develop a new system for pulmonary nodules "intelligent evaluation and management" cloud plus end software to improve the quality for front-line doctors and experts
- Cooperate with CIBN Health Tech to develop an upgraded version of OTT all-in-one machine
- Cooperate with SANMED, East China University of Science and Technology, Shanghai Jiaotong University, etc.,

Application Area 2: nCapp Intelligently Assists in Detection of Viral Pneumonia to Reduce Mortality Rate of It, such as COVID-19

- To establish a Cube for the diagnosis of viral pneumonia
  - ✓Single cylindrical independent single room
  - ✓ID card/medical insurance card + face recognition
  - ✓Automatic temperature measurement and flow adjustment
  - ✓Automated portable X-ray scanner (patent applied)
  - ✓Cough and other voice recognition
  - ✓Automated disinfection
- Cooperate in the research and development of the "intelligent assessment and management" cloud-added software for monitoring the recurrence of infectious diseases

Application Area 3: Precise Management of COPD to Reduce Acute Exacerbation and Mortality

- Cooperated with HUIzhong Health in MioT
- Cooperated with Huawei for MioT in Transmission and artificial intelligence
- Cooperated with Xeek (Xiamen) Medical Equipment Co., Ltd. to transform our transferred patent "an IoT PM2.5 pressure based lung function detection system" into a product
- Cooperating with United Crest Telemedicine Health Service (China) Co., Ltd. to develop a chip that can transmit the signals detected by physiological and pathological sensors to cloud computing, breaking the current information island effect
- Cooperated with Zhejiang Yiliankang to develop wearable exercise lung function monitoring equipment

Platform Expansion and Large-scale Cooperation

Simplification of complex problems, digitization of simple problems, proceduralization of digital problems, and systemization of procedural problems

Cell phone app

- PNapp5A
- SCapp5A
- nCapp5A
- COapp5A
- ASapp5A
- OSapp5A
- ARapp5A

IAIH cloud

- Lifetime storage
- Cloud interconnection
- Close monitoring
- Interact
- Full perception
- Reliable transmission
- Intelligent processing
- Benefit all beings

Function and service

- Online medical
- Offline medical
- Graded diagnosis and treatment
- Health management
- QC
- Popular Science and Professional Education
- Prescription over-the-counter drugs
- Insurance

Research and cooperation

- Develop 5Aapp according to PNaap5A template
- Mobile platform cooperation
- Online and offline services
- Health management cooperation
- Internet medical platform
- Online drug cooperation
- Medical device cooperation

Three links, full time and space, integrating the four population in them, quality control, prevention, diagnosis and treatment, a brand-new model that benefits all living beings

Platform was selected as National 5G+ Project, Launched Innovation Center of AI for Respiratory Health, China

Platform of AI management for Pulmonary nodules was selected as National 5G+ application project

Chunxue Bai was appointed as Chief of the Center

Pro. Zhong was congratulating the Center launching

Thanks for Your Attention!

Welcome to the 17th ISRD and the 2nd IAIH Conference
Conference theme: IoT Health, Smart Benefits for All Living Beings
Organizers: International Society of Respiratory Diseases, People's Government of Nanhu District, Jiaxing International Smart Health Alliance
Meeting time: November 26-28, 2021
Venue: Nanhu Hotel, Jiaxing City

二维码申请加入中国肺癌防治

Welcome to scan the QR code in the middle and apply to become a member of the Double League, realizing the vision of "famous doctors cure diseases, great doctors benefit all living beings"!