HSPA 2025

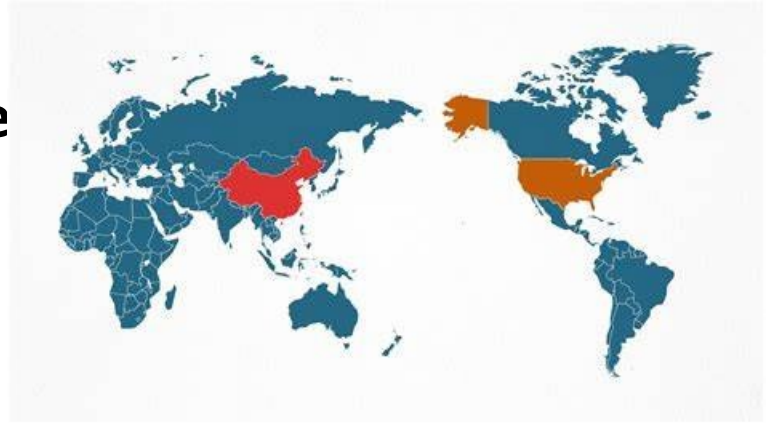
Construction of an AI-enabled SPD in a Chinese Hospital

Beijing Anzhen Hospital

Jin WANG

Jin WANG, M.N.S

- Head Nurse of SPD, Beijing Anzhen Hospital, Capital Medical University
- 18 years of experience in SPD operation and manageme
- Secretary of the SPD Committee of the Chinese Nursing Association(CNA)
- Deputy Director of the SPD Committee of the Beijing Nursing Association



Beijing Anzhen Hospital

- Set up on April 4, 1984
- National Cardiovascular Center
- Leading cardiovascular center in the world
- …

CONTENT

- #1: A Manual plus Partial Mechanical Reprocessing SPD (2008 – 2012, SPD 1.0)
- #2: An automation and digitalization SPD (2013 – Now, SPD 2.0)
- #3: An AI-Enabled SPD (2022 – Now, SPD 3.0)
- #4: Experience and lesson
- #5: Future Prospect

#1

A Manual plus Partial Mechanical Reprocessing SPD (2008 – 2012, SPD 1.0)

Background - Overview of the SPD at That Time

- Area: 217 square meters, consisting of 7 separate rooms and one corridor
- Equipment: 1 unit of Washer-Disinfector (WD), 2 units of steam sterilizer
- Personnel: 12 staff members
- Responsibilities: In charge of decontamination and sterilization of reusable medical devices from the wards

The exterior view of the SPD at that time

Background - Reasons for SPD Renovation

- On August 8, 2008, the 29th Summer Olympic Games were held in Beijing;
- Our hospital is only 2 kilometers away from the Bird's Nest;
- Our hospital was designated as one of the official hospitals for the Olympics.


Bird's Nest Stadium
2 km
Anzhen Hospital
搜地点、查公交、找路线
路线
北京市
路况
地铁
工具箱
慧忠北路
小营北路
京投大厦
风中圣火雕塑
两个人的世界雕塑
科学院-南里
中国科学院科学园小区
岔道口
北京冠军墙
亚运村
中国石油勘探开发研究院
塔院城市森林公园
奥运村
安翔北路
北辰东路
慧忠路
欧陆经典社区
志新路
云海雕塑
国家体育场
小营路
育慧里社区
新辰里
泰山五行石
北京奥运博物馆
北京联合大学
北京科技大学
山门殿
中国电子科技集团公司第十五研究所
牡丹观赏园
北四环
学院桥
健翔桥
惠新西街北口
西藏大厦
奥体中心
苇子坑
北京大学(学院路校区)
北极寺
国家奥林匹克体育中心
北辰西路
北京中华民族博物院
安定路
惠新西街
安苑路
惠新东街
芍药居
花园北路
花园东路
唐人街购物中心
对外经济贸易大学
曹八里村
惠新里社区南区
翠微百货
花园路街道
北土城
安贞门
惠新西街南口
北土城东路
健德门
牡丹园
西土城
联通网络中心大楼
808大楼
北京泰富酒店
京藏高速
中日友好医院
北三环中路43号院
安贞里小区
北辰路
北京公交集团和平东桥场站
和平西桥
光熙门
安贞桥
12号线
安华桥
马甸桥
北太平庄
蓟门桥
安华里社区
双旗杆社区
安华西里
社区服务站新外大街3号
和平里西街
和平里东街
和平家园
3D
全景
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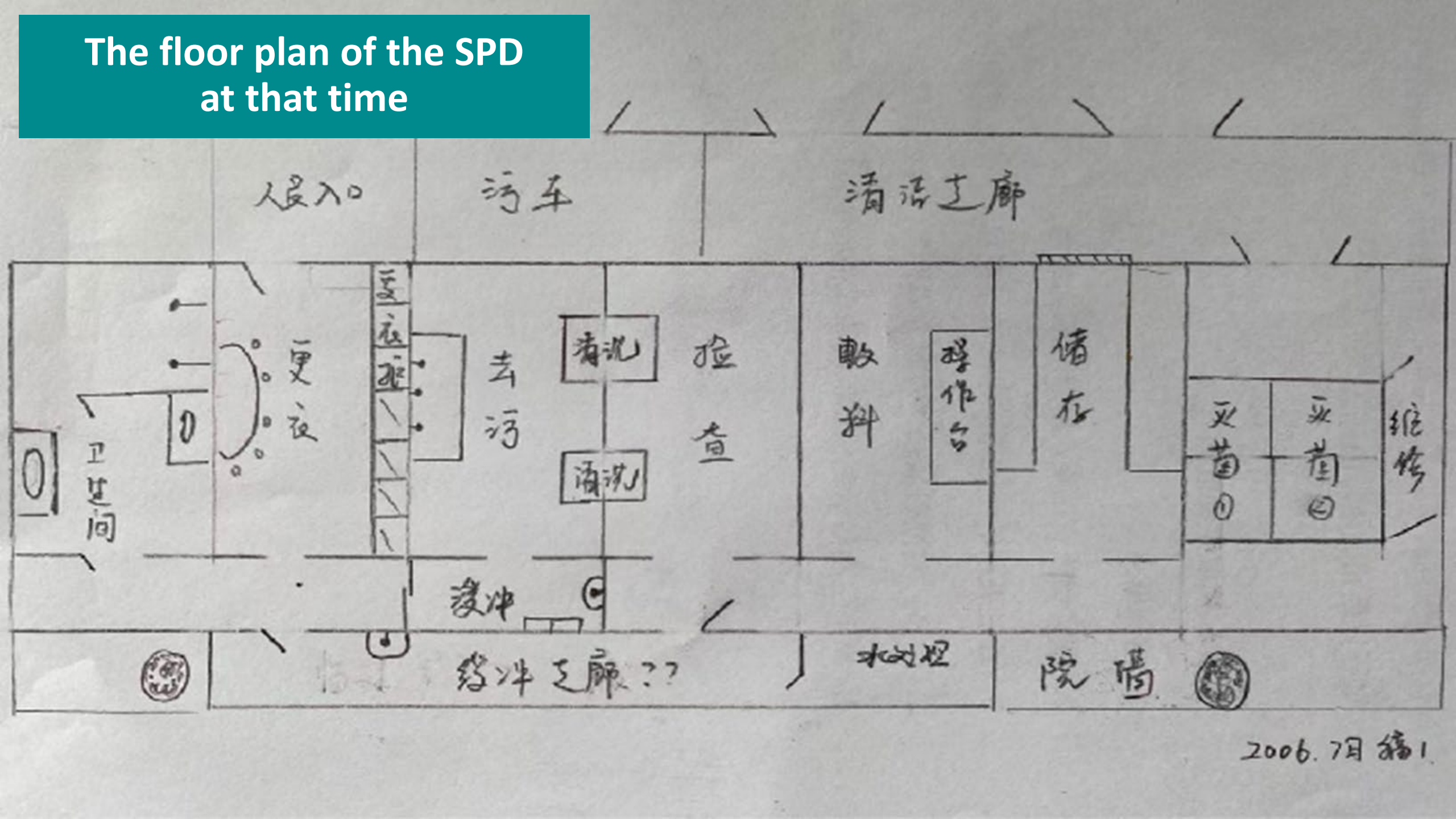
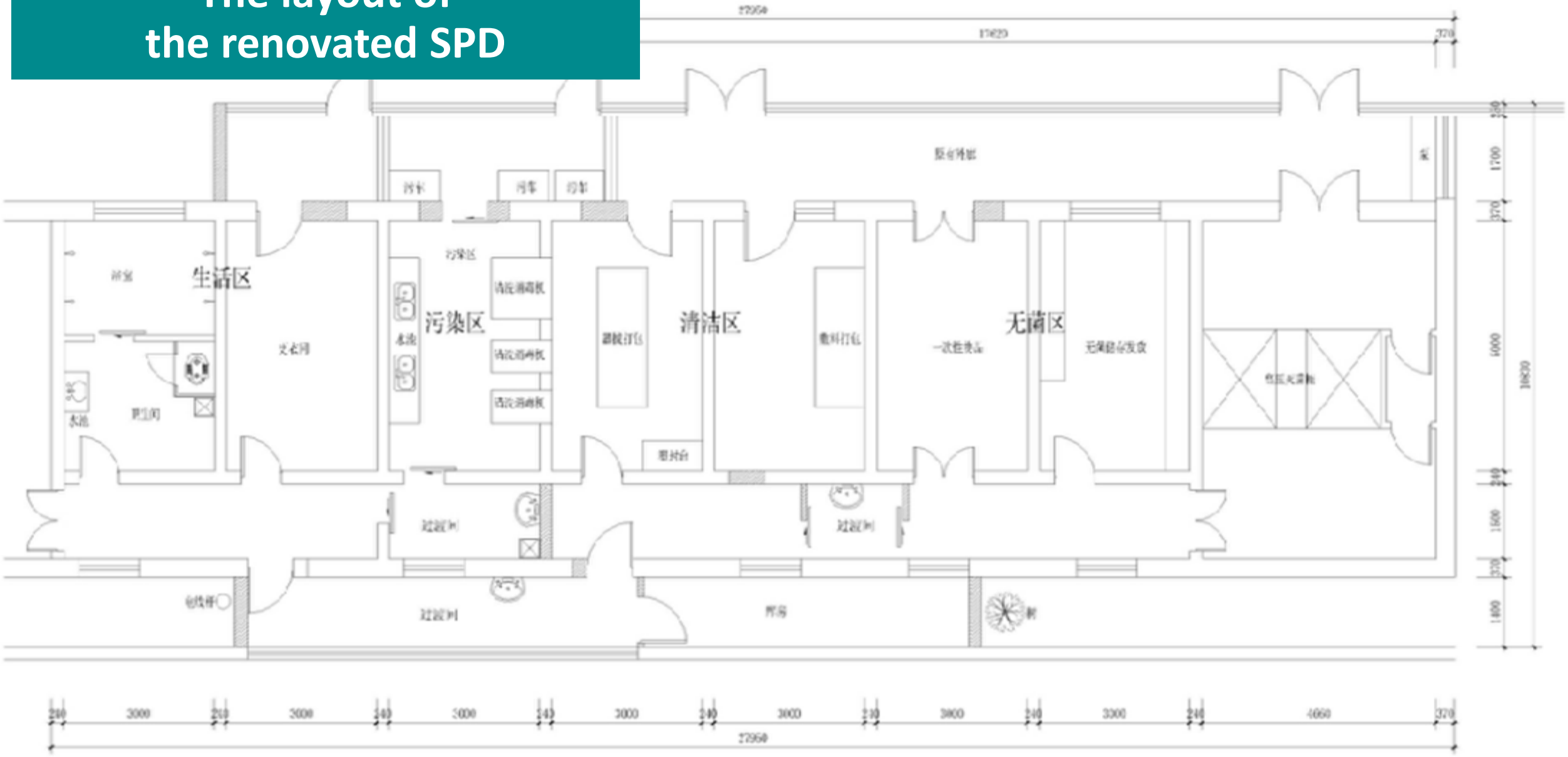
The floor plan of the SPD at that time



The layout of the renovated SPD



P-01 平面布置图
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Improvements of the Renovated SPD Compared to the Previous One

- Rationalization and standardization of personnel and logistics routes;
  - Redivision of some areas;
  - Separation of the contaminated area and the clean area by the front corridor;
  - Construction of a back corridor as a buffer zone;
- Addition of one more Washer-Disinfector.

Summary of SPD 1.0

- Decentralized management (only reprocessing reusable instruments from the wards);
- Limited number of washer-disinfector, sterilization equipment, and ancillary devices;
- Low level of automation, with no software or information system.

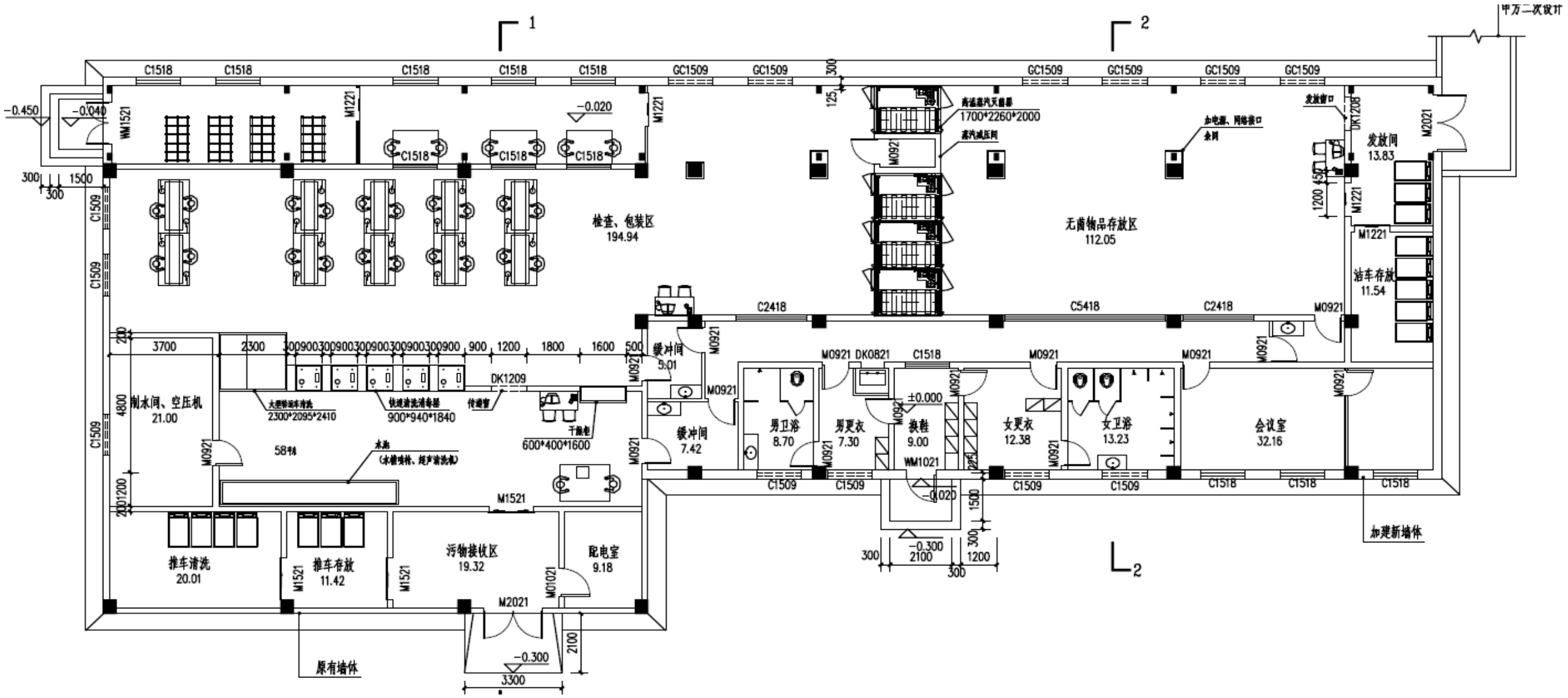
#2

An automation and digitalization SPD (2013 – Now, SPD 2.0)

Background - Why a New SPD Was Built

- The National Health Commission of China introduced new sterile reprocessing standards, advocating centralized management of SPDs.
- Our hospital’s numbers of outpatients and surgical operations have been increasing year by year.
- The existing SPD could no longer meet the requirements of the regulations and the hospital's development.

The layout of the newly-built SPD



Decontamination Area

Inspecting and Packaging Area

Sterile Storage Area

Main Equipment Configuration

- Washer-disinfectors, 13 units
- Steam sterilizers, 4 units
- Vaporized hydrogen peroxide low-temperature sterilizers, 4 units
- Ethylene oxide low-temperature sterilizers, 1 unit
- Ultrasonic cleaners, drying cabinets, sealing machines, etc.
- Traceability and quality management system, 1 set
- All members of our SPD, with the aforementioned equipment and facilities, provided sterile sets for 20,098 cardiac surgeries and 53,227 interventional surgeries in 2024.

Summary of SPD 2.0

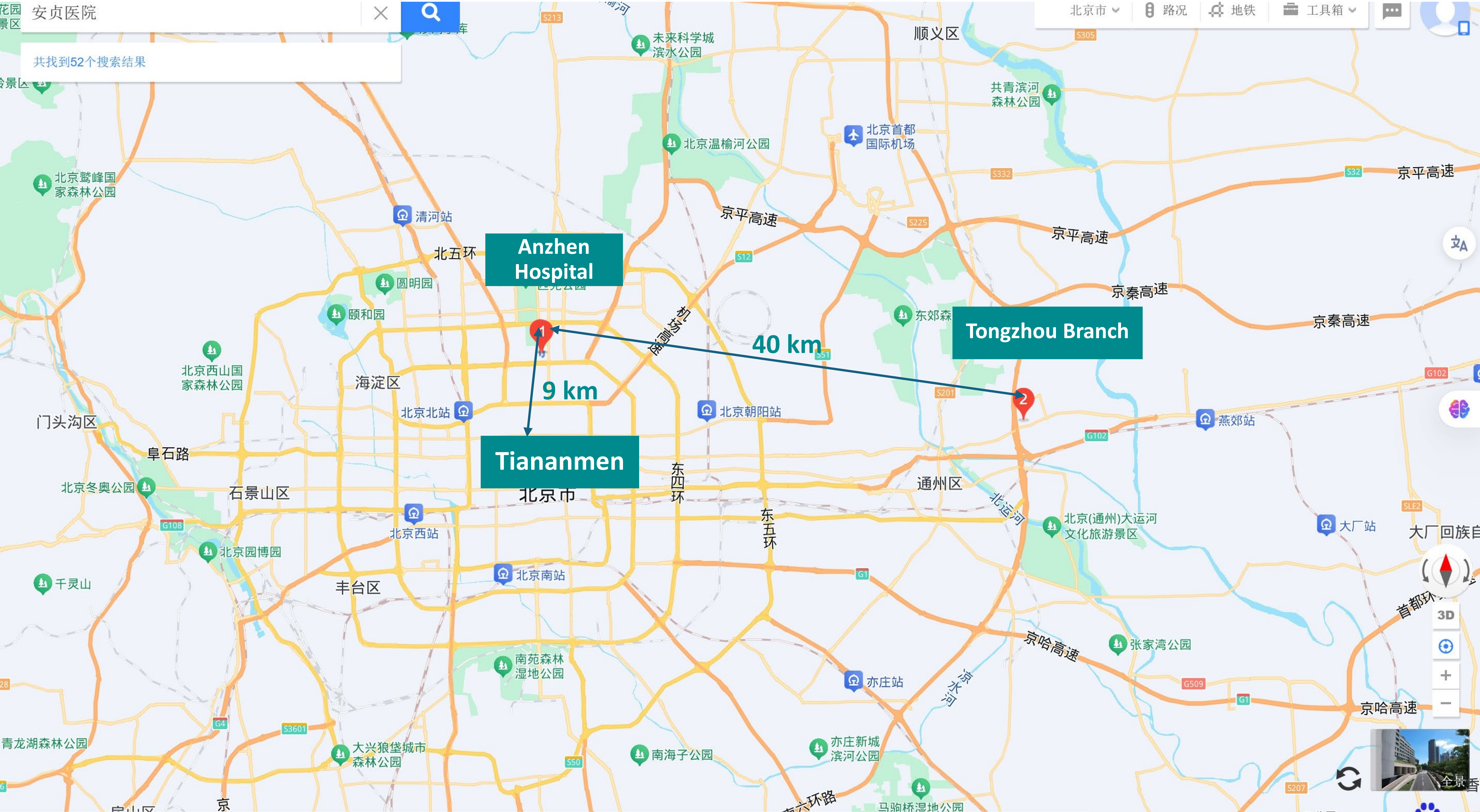
- Centralized management (reprocessing reusable instruments from operating theaters, wards, and other departments);
- Comprehensive configuration of washer-disinfectors, cleaning and disinfection, sterilization equipment, and ancillary devices;
- Low level of automation, with a significant amount of manual labor;
- Equipped with a traceability management system.

#3

An AI-Enabled Newly-Built SPD (2022 – Now, SPD 3.0)

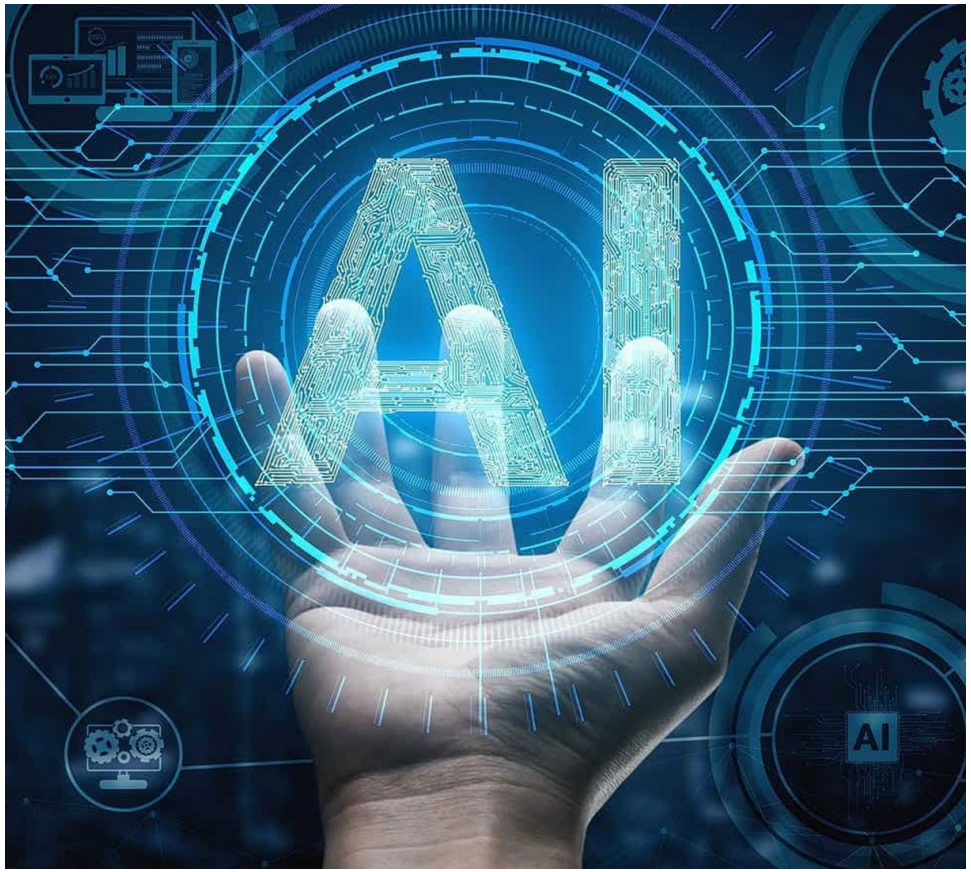
Background - New Branch Hospital

- In September 2021, the Beijing Municipal Health Commission released the "Beijing Special Plan for Medical and Health Facilities (2020 - 2035)". The plan proposes that a Tongzhou branch of Anzhen Hospital will be added to the Beijing city sub-center.
- The Tongzhou branch of Anzhen Hospital has a construction area of 340,000 square meters, with two underground floors and ten above-ground floors, and it will have 1,300 beds.
- It aims to build a research-oriented hospital and an internet hospital that are leading in China and world-class, with a focus on cardiovascular diseases.


Anzhen Hospital
Tongzhou Branch
Tiananmen
40 km
9 km
安贞医院
共找到52个搜索结果
北京市
路况
地铁
工具箱
顺义区
未来科学城滨水公园
共青滨河森林公园
北京首都国际机场
北京温榆河公园
北京鹫峰国家森林公园
清河站
京平高速
北五环
圆明园
颐和园
东郊森
京秦高速
北京西山国家森林公园
海淀区
北京北站
北京朝阳站
燕郊站
门头沟区
阜石路
北京冬奥公园
石景山区
北京市
东四环
通州区
北运河
北京(通州)大运河文化旅游景区
大厂站
北京西站
北京园博园
东五环
千灵山
丰台区
北京南站
京哈高速
张家湾公园
南苑森林湿地公园
亦庄站
青龙湖森林公园
大兴狼堡城市森林公园
南海子公园
亦庄新城滨河公园
马驹桥湿地公园
3D
全景

Background - Technology and Society

- Human society has gone through the agricultural age, the industrial age, and the information age, and is now in the intelligent age.
- On November 30, 2022, ChatGPT was released, generating a buzz worldwide and marking a new stage in the intelligent age.
- In the intelligent age, AI has become a core tool, data is the new “oil,” and algorithms are the new “engine”.
- The positioning of the new branch hospital's SPD: an AI-enabled SPD.



What emerging technologies have been applied in SPD?

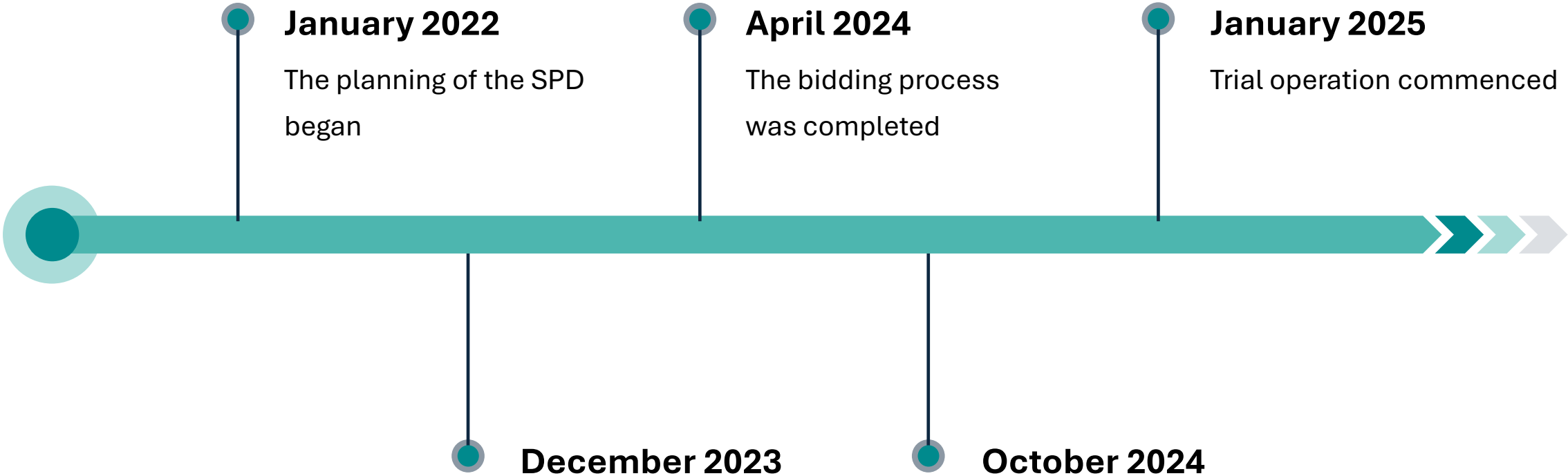
Technologies	Mgmt.	Decontamination Area	Inspection and Packaging Area	Sterile Storage Area
Video recording analysis	✓	✓	✓	✓
Facial recognition		✓	✓	✓
Electronic BD testing			✓	
RFID identification and traceability		✓	✓	✓
Software for BI and CI monitoring			✓	✓
Visual recognition of instruments			✓	
Transfer by AMR		✓	✓	✓
Automatic Loading/Unloading		✓	✓	
Packing Robot			✓	
Track logistics transportation system				✓
Central Dosing System		✓		
Staff training by AR/VR	✓	✓	✓	

The Principles of the New SPD Construction

- Make good use of the existing experience and data
- Effectively utilize automation and digital technologies
- Ensure the improvement of work quality and efficiency, as well as care for staff

The positioning of the new branch hospital's SPD: an AI-enabled SPD.

SPD Birth/Construction Timeline



January 2022

The planning of the SPD began

December 2023

The drawings and plans were finalized

April 2024

The bidding process was completed

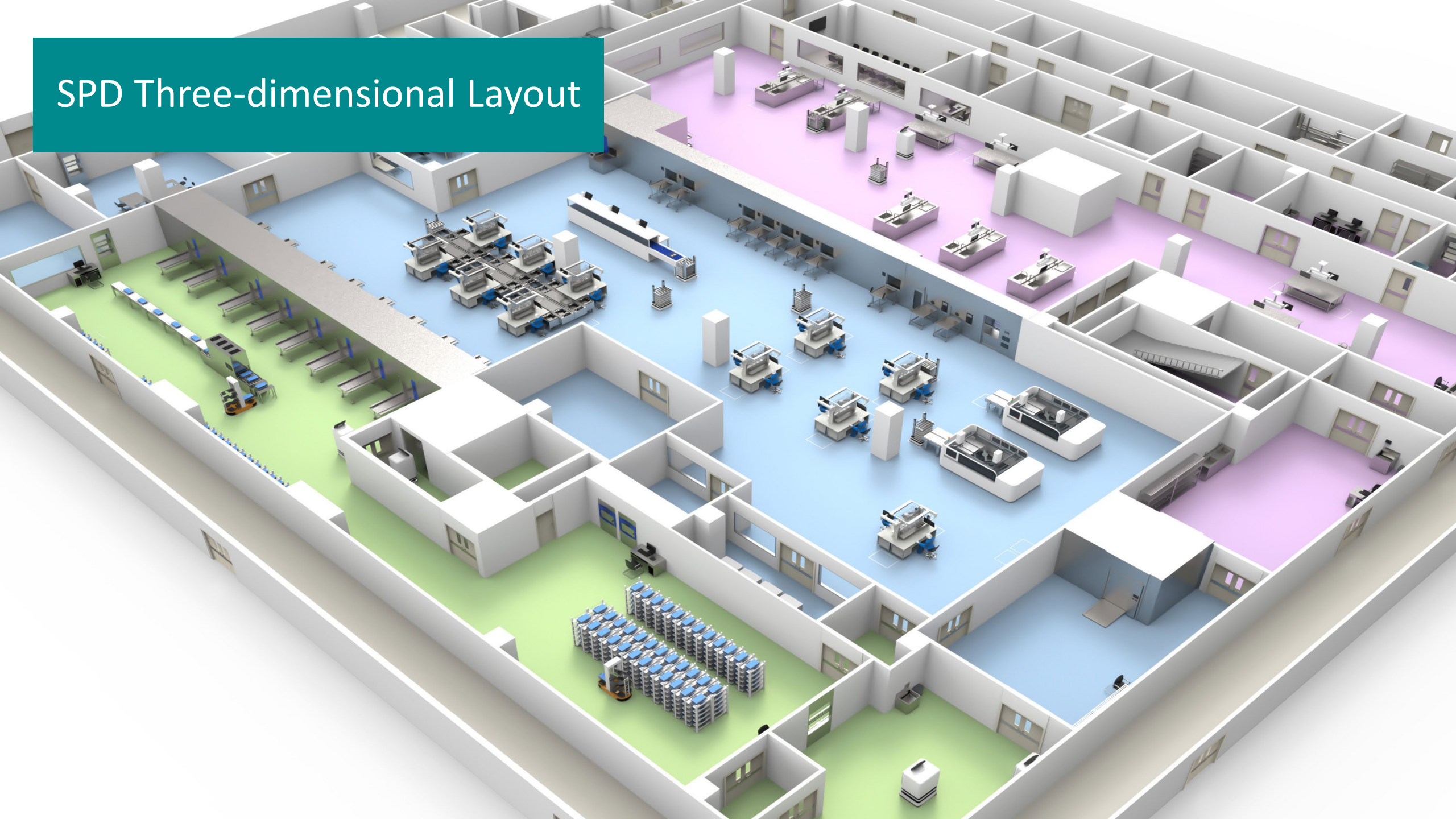
October 2024

The main equipment arrived successively and began to be installed and tested

January 2025

Trial operation commenced

SPD Three-dimensional Layout



Decontamination Area: Automatic Detergent Dispensing

- Centralized supply of X types of cleaning agents has been realized.
- The agents have been connected with: Instrument WDs, Tunnel WD, Trolley WD.
- Future Expansion 1: with Cleaning Sinks
- Future Expansion 2: Integration with the system platform

Decontamination Area: Robotic Collection of Used Instruments from Operating Theaters

- Robotic collection is carried out by a dedicated elevator that directly connects SPD and operating theaters.
- The robots are of the lifting type and can move autonomously.
- The standard number of sterilization baskets that can be transported in one trip is 6.
- The maximum load capacity of the robot is 300 kilograms.
- The maximum speed of the robot is 2 meters per second.

Decontamination Area: Automatic Loading of Cleaning Racks

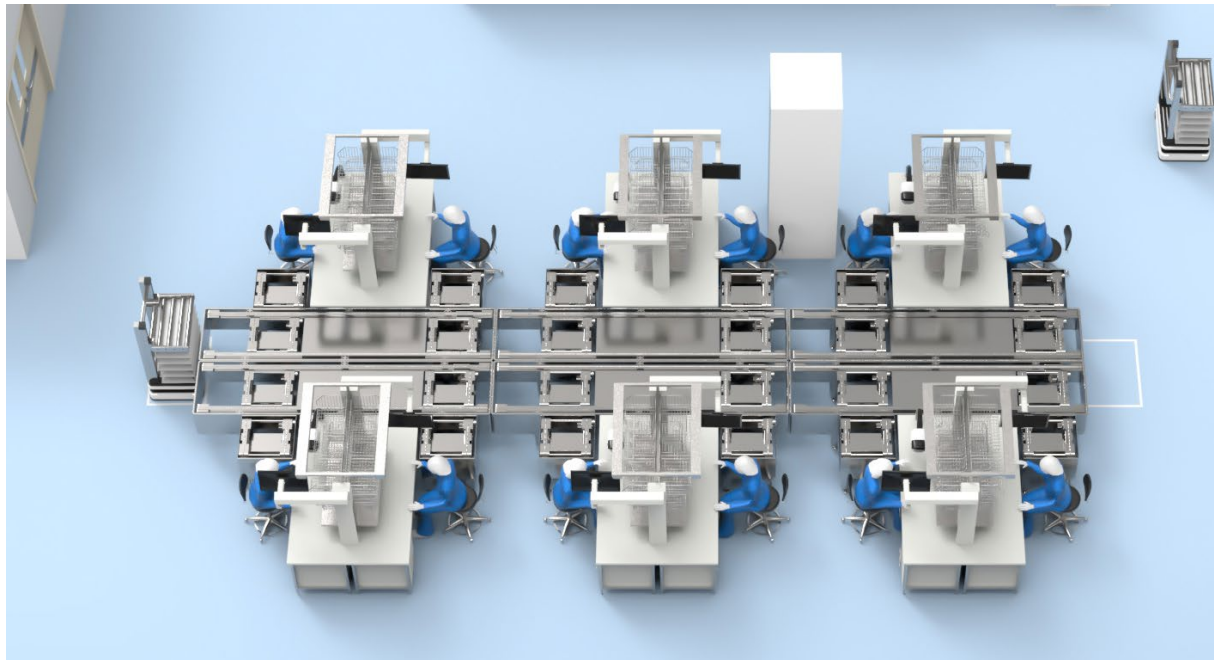
- 8 Instrument WDs, and 1 Tunnel WD have achieved automatic loading of cleaning racks.
- In other words, each of these machines has its own corresponding loading station.
- Future expansion: Using AMR (Autonomous Mobile Robot) to automatically transport cleaning racks to the loading stations.

Inspection and Packaging Area: Automatic unloading of cleaning racks

- Five Instrument WDs, and one Tunnel WD have achieved automatic unloading of cleaning racks.
- In other words, each of these machines has its own corresponding unloading station.
- Future expansion: Using AMR (Autonomous Mobile Robot) to automatically transport cleaning racks to the unloading stations.

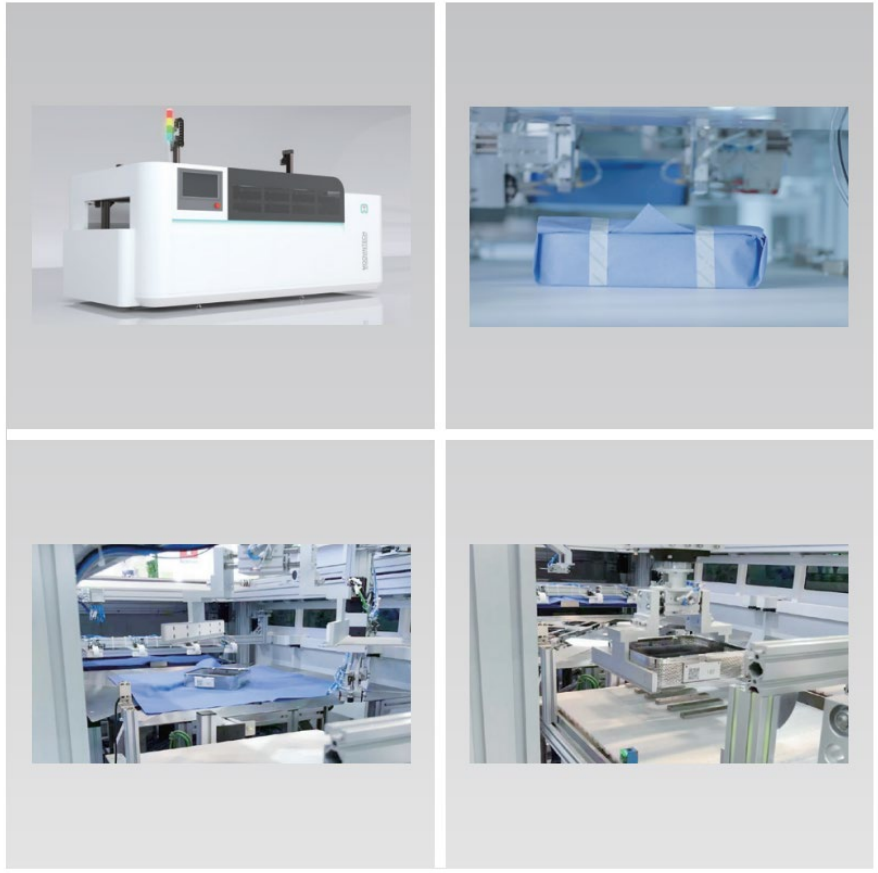
Inspection and Packaging Area: Intelligent distribution system of Items to be Packaged

- Intelligent directional distribution of instrument packs that need to be packaged, with the allocation logic including:
  - Urgency level;
  - Specific personnel (professional skills);
  - Specific workstations;
  - Combinations of the above.



Inspection and Packaging Area: Robotic Packaging

- packaging system:
  - Automatic loading
  - Non-woven wrapping materials automatic feeding
  - Multi-layer packaging
  - Tape closing
  - Intelligent Labeling
  - Packaged sets automatic unloading
  - Robotic transfer



Inspection and Packaging Area: Inside Robotic transfer

- In the inspection and packaging area, robotic transfer of most instruments/instrument sets has been realized, specifically including:
  - From the inspection/sorting workstation to the packaging robot;
  - From the inspection/sorting workstation to the intelligent distribution system;
  - From the packaging robot to the temporary storage area for items to be sterilized;
  - From the packaging table to the temporary storage area for items to be sterilized.

Sterile Storage Area: Intelligent warehousing system

- The intelligent storage, pick-up and real-time status display of sterilized items have been realized. The entire system includes:
  - Intelligent warehousing robots
  - Storage racks with QR code positioning
  - Inbound and outbound workstations
  - Warehouse Management System (WMS)
- The entire system operates on the Intelligent Sterile Processing Operation Platform.

Sterile Storage Area: Railway Logistics Transport System

- Railway Logistics Transport System is used for the transmission of small packages;
- It is connected to a total of 59 clinical departments.

AI Capability achieved in my SPD

1). Intelligent Sterile Processing Operation Platform

2). Decontamination Area: Automatic Detergent Dispensing, Robotic Collection of Used Instruments from Operating Theaters, Automatic Loading of Cleaning Racks

3). Inspection and Packaging Area: Automatic unloading of cleaning racks, Inside Robotic transfer, Intelligent distribution of Items to be Packaged, Robotic Packaging

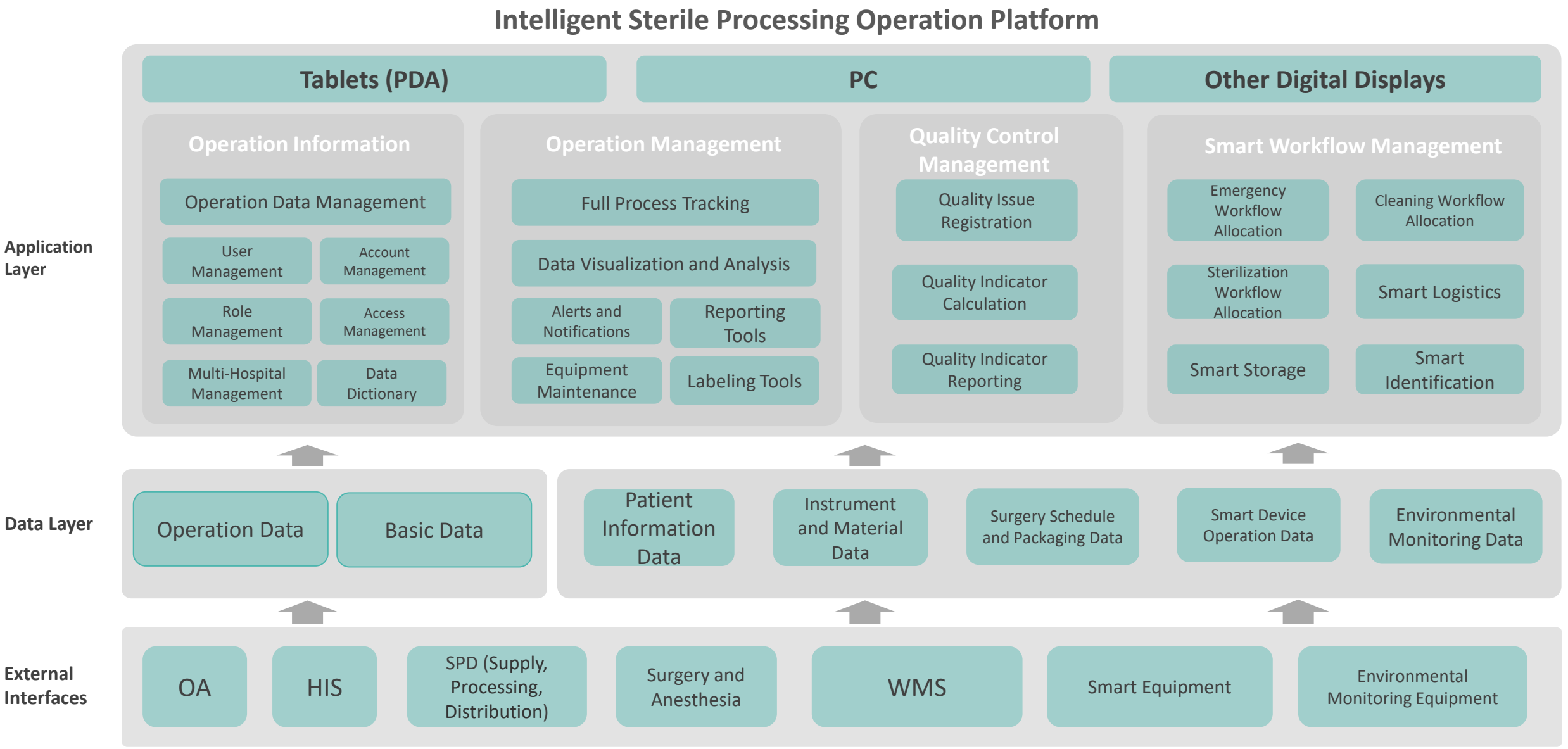
4). Sterile Storage Area: Intelligent Warehousing System, Railway Logistics Transport System

5). Digital Twin

Intelligent Sterile Processing Operation Platform

- It is not merely a traceability software; the tracing of items is its fundamental function.
- It is a platform interfacing with all SPD equipment (including Instrument WDs, Tunnel WD, Trolley WD, high-temperature sterilizers, ethylene oxide low-temperature sterilizers, vaporized hydrogen peroxide low-temperature sterilizers, etc.).
- It is the operating platform for all robotic operating systems (including transfer robots, packaging robots, warehousing robots, etc.).
- It is a platform for data collection (including instruments, instrument sets, consumables, personnel, media, environmental parameters, etc.).
- It is a platform for integration with external software systems (such as hospital information systems, office automation systems, anesthesia and surgery systems, nursing systems, etc.).
- It is a platform for implementing algorithms and intelligence.

Platform Architecture



Digital Twin

- Real-time display of the SPD's working status in virtual space, including:
  - Display and statistics of overall workload;
  - Display and statistics of workload by individual area and individual step;
  - Working status of key equipment;
  - Operating status and location of all robots;
  - Energy consumption (water, electricity, steam, etc.);
  - Temperature and humidity status of each area.


INTELLIGENT DISTRIBUTION SYSTEM

Summary of SPD 3.0

- Centralized management (reprocessing reusable instruments from operating theaters, wards, and other departments);
- Comprehensive configuration of washer-disinfectors, cleaning and disinfection, sterilization equipment, and ancillary devices;
- High level of automation, equipped with transfer robots, packaging robots, warehousing robots, etc., with minimal manual labor;
- Features an Intelligent Sterile Processing Operation Platform, which goes beyond traceability by using algorithms for work priority allocation and achieving digital twin functionality.

#4

Experience and Lesson

	SPD 1.0	SPD 2.0	SPD 3.0
Period	2008 - 2012	2013 – Now	2022 – Now
Application Campus	Main Campus	Main Campus	Tongzhou Branch
Number of working Staff	12	42	23
Total Area (Square meters)	217	740	2000
Management	Decentralized	Centralized	Centralized
Configuration of Main Sterilization and Disinfection Equipment	Not as many	Comprehensive	Comprehensive
Level of automation	Extremely low	Low	High
Informative Software and Traceability	NO	YES	YES
Intelligent Sterile Processing Operation Platform and Digtial Twin	NO	NO	YES

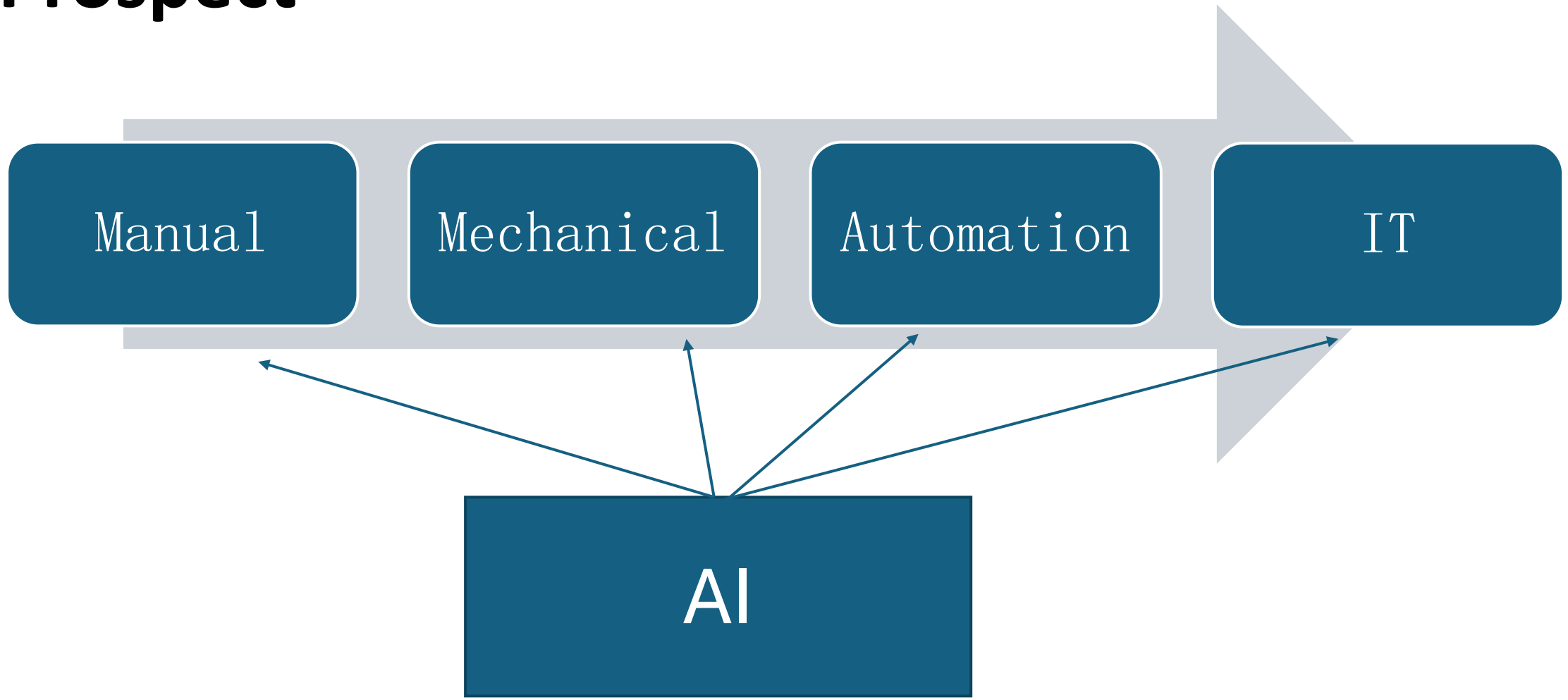
#5

Future Prospect

More Actions

- With the operation of the Tongzhou branch's SPD 3.0, based on an intelligent operation platform and using AI as a tool, we will continuously analyze data, optimize algorithms, and improve the operational efficiency of the SPD.
- We are also planning to upgrade the SPD 2.0 currently in operation at the main campus to an AI-enabled intelligent SPD.
- We will share the experiences and lessons learned in the operation and management of SPD 1.0, SPD 2.0, and SPD 3.0 with our peers in the sterile reprocessing field to promote mutual improvement and advancement.

Prospect



AI

- Artificial intelligence systems work through a combination of algorithms, data, and computing power.

1. Data collection
2. Data pre-processing
3. Algorithm selection
4. Model training
5. Model evaluation
6. Model deployment
7. Continuous learning and improvement
8. Reasoning and decision-making

SEEQ Principle

- Safe
- Efficacy
- Efficiency
- Quality

HSPA 2025

Thank you for your attention!

Jin WANG

Tel.: +86 -133 7010 3031

Email: azxdgyzx@163.com