NCDs Control and Big Data Platforms for Health Policy in China: Experiences from Zhejiang Province

Zhejiang Provincial CDC, China

Jieming Zhong

October, 2017
1. NCDs Surveillance System in Zhejiang

2. Challenges and Opportunities: Prevalence of NCDs in Zhejiang

3. Big Data of NCDs in Zhejiang
Zhejiang Province is located on southeast coast of China, which covers a total land area of 101,800 sq km. There are 11 cities and 89 counties (including districts at the county level). The total population of the province is 55 millions.
NCDs Surveillance System in Zhejiang
History of NCDs surveillance Development in Zhejiang

- **2001**: Monitoring regions were established in 30 districts, covering 3.56 millions people;
- **2006**: 16 millions people were covered in monitoring regions;
- **2009**: NCDs Surveillance system which covered whole population was established
- **2010**: Conduct the connection of surveillance data in excel with WebService in site areas;
- **2011**: Develop and publish the first edition of “Application standards of network reporting of NCDs for hospital in Zhejiang", followed by two revision.
- **2013**: Community NCD management system was established.
- **2014**: Community chronic disease (hypertension, diabetes) patient management module running;
- **2015**: Development of offline audit clean-up software for death and NCDs data succeeded; Regional platform surveillance data exchange accomplished in site area at the end of December.
NCDs Surveillance and Management Information System in Zhejiang

HIS systems of 29 hospitals connected with NCDs Surveillance system

NCDs Surveillance system covered whole population was established

HIS systems of 55 hospitals connected with NCDs Surveillance system

2009

NCDs Surveillance and management system establishing

Community NCDs management system was established

HIS systems of 456 hospitals connected with NCDs Surveillance system

2012

2010

2016
Map of the first 30 Districts for Surveillance in Zhejiang

The districts in dark blue are first surveillance areas.
The integrated network direct reporting system covers life registration, case reports of NCDs, survival follow-up and monitoring, and NCDs patient community management.

Four levels of data collection or management: Provincial CDC, Municipal CDC, District (county) CDC, hospital and community health service institution.
NCDs Surveillance in Zhejiang

—–What are covered by surveillance?

- Birth, death, 4 main NCDs incidence surveillance (Diabetes, Cancer, Stroke, Acute coronary heart disease )

- Adult behavior risk factor surveillance: Began in 2004, conducted every 3 years (30 counties)

- Adolescent behavior risk factor surveillance: Began in 2007, conducted every 5 years (30 counties)
1. Community NCDs management summary report

- Summary reports of hypertension, diabetes, blood measure for first outpatient service, once a quarter;
- Summary reports of local population information, health record, once a year;
- Reports are checked step by step from community health center to county CDC, municipal CDC and finally by provincial CDC.

2. Case information collection of NCD management

- Summary reports of hypertension, diabetes, blood measure for first outpatient service, once a quarter;
- Data collection: health record and community management information of patients with hypertension and diabetes. Now it is still in progress.
Challenges and Opportunities: Prevalence of NCDs in Zhejiang
Life Expectancy from 1995 to 2016

The average life expectancy in Zhejiang was **73.09** years old in 1995 and **78.40** years old in 2016. It has risen by **5.31** years old during the past 21 years.
The trend of the causes of death from 1973 to 2016

NCDs have been the main cause of death in the whole province. Its proportion of all deaths was increasing rapidly and reached to 83.04% in 2016.
Causes of Death in Zhejiang, 2016

Cancers, cerebrovascular diseases, chronic respiratory diseases, heart diseases and diabetes accounted for 78.73% of all deaths.
The standardized mortality rate of **diabetes** rose by **250%** and the chronic respiratory diseases declines by **70%** from 1990 to 2016.
# The Mortality of Top 10 Cancers in 2016

## Cancers Mortality rate (1/100,000)

<table>
<thead>
<tr>
<th>Cancers</th>
<th>Mortality rate (1/100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer</td>
<td>79.74</td>
</tr>
<tr>
<td>Liver cancer</td>
<td>42.11</td>
</tr>
<tr>
<td>Gastric cancer</td>
<td>32.87</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>18.91</td>
</tr>
<tr>
<td>Esophagus cancer</td>
<td>16.63</td>
</tr>
<tr>
<td>Pancreatic Cancer</td>
<td>10.40</td>
</tr>
<tr>
<td>Prostate Cancer</td>
<td>6.67</td>
</tr>
<tr>
<td>Leukemia</td>
<td>5.18</td>
</tr>
<tr>
<td>Cerebroma</td>
<td>4.84</td>
</tr>
<tr>
<td>Bladder cancer</td>
<td>3.85</td>
</tr>
<tr>
<td>Total</td>
<td>221.20</td>
</tr>
</tbody>
</table>

## Cancers Mortality rate (1/100,000)

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<tbody>
<tr>
<td>Lung cancer</td>
<td>28.76</td>
</tr>
<tr>
<td>Liver cancer</td>
<td>14.63</td>
</tr>
<tr>
<td>Gastric cancer</td>
<td>14.17</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>12.95</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>7.75</td>
</tr>
<tr>
<td>Pancreatic Cancer</td>
<td>7.19</td>
</tr>
<tr>
<td>Cervical cancer</td>
<td>4.75</td>
</tr>
<tr>
<td>Cerebroma</td>
<td>3.90</td>
</tr>
<tr>
<td>Esophagus cancer</td>
<td>3.84</td>
</tr>
<tr>
<td>Leukemia</td>
<td>3.76</td>
</tr>
<tr>
<td>Total</td>
<td>101.70</td>
</tr>
</tbody>
</table>

Data resource: The monitoring data of death rate in Zhejiang
The Mortality of Cancer in 2016

- The mortality of cancer was **189.18 per 100,000** (urban: 186.74 per 100 000; rural: 190.53 per 100 000);

- The top five cancers were the same in urban and rural areas, which accounted for **68.45%** and **71.55%** of all cancer deaths, respectively.

The mortality of the top five cancers in urban and rural areas in Zhejiang in 2016 (per 100 000)
The cancers with ascending mortality rate were lung cancer (103.47%), colorectal cancer (147.06%) and cervical cancer (68.44%). The cancers with descending mortality rate included gastric cancer (28.97%) and liver cancer (5.28%). The mortality rate of esophagus cancer held the line.
Incidence Surveillance of NCDs

Case report number of four main NCDs from 2009 to 2016
The trend of incidence of four main NCDs from 2005 to 2016

The incidence rates of stroke, diabetes, cancers and acute coronary heart disease events in 2016 rose by 95.63%, 219.60%, 64.30% and 117.17% compared with 2005.
The average age at diagnosis of diabetes from 2009 to 2016
### The Incidence of Top 10 Cancers in Zhejiang, 2016

<table>
<thead>
<tr>
<th>Cancers</th>
<th>Incidence (1/100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer</td>
<td>89.46</td>
</tr>
<tr>
<td>Gastric cancer</td>
<td>47.32</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>43.82</td>
</tr>
<tr>
<td>Liver cancer</td>
<td>41.39</td>
</tr>
<tr>
<td>Prostate Cancer</td>
<td>20.04</td>
</tr>
<tr>
<td>Esophagus cancer</td>
<td>18.36</td>
</tr>
<tr>
<td>Thyroid cancer</td>
<td>15.94</td>
</tr>
<tr>
<td>Bladder cancer</td>
<td>10.62</td>
</tr>
<tr>
<td>Pancreatic Cancer</td>
<td>10.39</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>9.83</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>307.17</strong></td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Cancers</th>
<th>Incidence (1/100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid cancer</td>
<td>55.57</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>53.30</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>48.61</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>30.94</td>
</tr>
<tr>
<td>Cervical cancer</td>
<td>20.53</td>
</tr>
<tr>
<td>Gastric cancer</td>
<td>19.96</td>
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<tr>
<td>Liver cancer</td>
<td>13.53</td>
</tr>
<tr>
<td>Cerebroma</td>
<td>12.30</td>
</tr>
<tr>
<td>Corpus carcinoma</td>
<td>10.15</td>
</tr>
<tr>
<td>Ovarian cancer</td>
<td>8.15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>273.04</strong></td>
</tr>
</tbody>
</table>

*Data resource: The monitoring data of incidence in Zhejiang*
The incidence of lung cancer, stomach cancer, liver cancer, colorectal cancer and breast cancer rose by 64.87%、18.04%、17.55%、54.65% and 85.56% in 2016 compared with 2005. The incidence rate of thyroid cancer reported in 2016 was 13.73 times higher than that in 2005.

Data resource: The monitoring data of incidence in Zhejiang
The prevalence rates of NCDs rose rapidly and in 2010 the cases of NCDs among adults has reached to:

- Hypertension (1064万)
- Diabetes (268万)
- Impaired glucose regulation (215万)
- Overweight (1223万), obesity (322万)
- Dyslipidemia (2221万)

National NCDs and Nutrition Examination Survey among Chinese adults in 2015:

- Hypertension: 26.70%
- Diabetes: 7.37%

Data resource: The NCDs survey in 2002 and 2010 in Zhejiang
Community Management of NCDs patients

Management of Hypertension and Diabetes from 2007 to 2016
Standardized Management of Hypertension and Diabetes from 2007 to 2016
Current situation of Hypertension and Diabetes Control from 2012 to 2016

(×10,000) (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of patients with blood pressure controlled</th>
<th>Number of patients with FBG controlled</th>
<th>Rate of blood pressure controlled</th>
<th>Rate of FBG controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>234.18</td>
<td>58.92</td>
<td>64.97</td>
<td>55.13</td>
</tr>
<tr>
<td>2013</td>
<td>285.82</td>
<td>60.84</td>
<td>57.53</td>
<td>63.53</td>
</tr>
<tr>
<td>2014</td>
<td>288.43</td>
<td>61.55</td>
<td>59.34</td>
<td>66.56</td>
</tr>
<tr>
<td>2015</td>
<td>282.32</td>
<td>67.68</td>
<td>55.90</td>
<td>68.75</td>
</tr>
<tr>
<td>2016</td>
<td>281.15</td>
<td>58.55</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comparison of the trend of Hypertension Prevalence Rate in Zhejiang Province with Developed Countries

<table>
<thead>
<tr>
<th></th>
<th>Zhejiang</th>
<th>USA</th>
<th>Canada</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19.80</td>
<td>23.56</td>
<td>28.1</td>
<td>29.1</td>
</tr>
<tr>
<td><strong>Annual rate of increase (%)</strong></td>
<td>2.20</td>
<td>0.39</td>
<td>0.54</td>
<td>0.59</td>
</tr>
</tbody>
</table>


McAlister FA. Changes in the rates of awareness, treatment and control of hypertension in Canada over the past two decades. CMAJ. 2011;183(9):1007-13.

Prevalence of NCDs Related Behavioral Risk Factors

➢ The prevalence of smoking (adult male) is 46.38%
➢ The prevalence of drinking (adult male) is 39.88%
➢ The prevalence of physical activity is 25.89%

➢ Average daily salt intake is 13.73g
➢ Average daily cooking oil intake is 48.07g

More than double the recommended amount

Comparison of average daily intake of salt and cooking oil in 2010 with recommended intake

Data source:
Surveillance of behavior risk factors in 2013 in Zhejiang
The surveys of chronic diseases in 2010 in Zhejiang
3 High of NCDs: High mortality, high morbidity, high prevalence. NCDs incidence and prevalence continues to rise, but the mortality maintains steady in recent years.

Behavior risk factors: High prevalence (the prevalence of smoking and drinking slightly decrease, but the prevalence of physical activity remained unchanged)

Other factors: such as aging, deficient prevention and control system of NCDs, regional development imbalance of NCDs prevention and control.

Slow down the increasing trend of NCDs!
Delay the onset age of NCDs, reduce early death!
Prevent severe complications!
Focus on social determinants, strengthen the government responsibility

Highlight community-based prevention and control of NCDs, and implement the integration of medical treatment and prevention

Improve the monitoring information system, and promote evidence-based decisions

Rely on CDC and strengthen technology management for NCDs control and prevention
Big Data of NCDs in Zhejiang

1. Big Data in Yinzhou District, Ningbo, Zhejiang, China

2. Big Data in Tongxiang city, Jiaxing, Zhejiang, China
Big Data in Yinzhou District, Ningbo, Zhejiang, China
About Yinzhou
Full view of big data in Yinzhou

General data overview:
1.22 million health records, 63580901 Outpatient records, 475188 Inpatient records

The increasing data:
Outpatient records: increasing 27279 records per day,
Outpatient charge details: increasing 211159 records per day;
Inpatient records: increasing 209 records per day,
Inpatient charge details: increasing 64755 records per day

Management of NCDs Patients:

<table>
<thead>
<tr>
<th>NCDs</th>
<th>Report records</th>
<th>Follow-up records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>120708</td>
<td>3928730</td>
</tr>
<tr>
<td>Diabetes</td>
<td>37131</td>
<td>779627</td>
</tr>
<tr>
<td>Cardiovascular and cerebrovascular diseases</td>
<td>8623</td>
<td>58745</td>
</tr>
<tr>
<td>Cancer</td>
<td>25525</td>
<td>57667</td>
</tr>
</tbody>
</table>
Full view of big data in Yinzhou

Basic Information
- Patient basic information
- Patient card information

Public Health
- Family health records
- NCDs information
- Disease control

E-medical Records
- Outpatient records
- Inpatient records

Health Resources
- Medical institution
- Health staff
- Drug information
- Medical expense

Health Service
- Health examination
- Patients outpatient
- Patients inpatient
The pre arrangement and classification of data have been completed, the platform is now in formal operation.
The Applications of the Health Data
“Chinese Electronic Health Records Research in Yinzhou” (CHERRY for short) was launched, “The study on the establishment and application of cardiovascular disease risk prediction model” which was based on the former study was funded as a major research project by the Chinese National Natural Science Foundation in 2015.
• The research group initially analyzed the comorbid status of NCDs and the risk of death.
• The results were communicated at the AHA/ASA2017 annual meeting in March 2017 and were published on Circulation (2017, 135:AP166).
This study selected 372,793 local registered permanent residents with health examination records. This study aims to explore the association between BMI and the risk of death.

Results have been published on Scientific Reports (2016;6:31609).
Recently, the research group analyze the association between blood pressure and the death risk. The result showed that the association between blood pressure and mortality risk was a U curve. The unstable blood pressure increasing the total death risk and cardiovascular disease death risk.
This research project is another application study in collaboration with the research group of Zhejiang University and the project has received 8 million yuan from Zhejiang University.

The ecological study was conducted by collecting air quality monitoring data in real-time and the summarize of the number of patients with respiratory diseases in real-time.

The results showed that PM2.5, PM10, NO2, SO2 can lead to the rise of respiratory diseases,. Among them, acute upper respiratory infection, pneumonia, COPD and asthma are the main rising diseases.
The figure shows the association between four air pollutants and the changes in the number of clinic visits with acute upper respiratory infection and acute lower respiratory infection in populations under 15 years old.

A cohort study including fifty thousand people will be carried out to verify the association in the future.
Combined with the local geographic information system, it can monitor the dynamic changes of various diseases in real time and find out the abnormal aggregation in space in time. It can be used for ecological study.
Big Data in Tongxiang city, Jiaxing, Zhejiang, China
About Tongxiang City
Big data: health records and their inpatient and outpatient visit information of all residents, NCDs and death surveillance, information of all hypertension and diabetes, individual health insurance record, and so on.

Data was compiled via three main sources: data: the diabetes management system, the social security system, and the death cause registry system in Tongxiang.

The diabetes management data provided demographic characteristics of individuals. Using the unique identification number in this data, we obtain the mortality from death cause data, and the healthcare expenditures for hospitalization, outpatient visits and self-medication from insurance claim data.
A medical insurance based study in Tongxiang

Research content:

1. T2DM-related direct medical cost;
2. Direct medical cost among patients with or without complications;
3. Direct medical costs among patients with different type of complications;
4. Direct medical costs among patients with different number of complications;
5. The effects of complications on direct medical costs.
The Prospect of the Health Data
To Enrich Health Data Sources

- Population Gene Test
- Population Lung Test
- Population Fundus Image
- regional Air Quality Data
- Health Records
  - Health Information
    - Health surveillance
    - Life behavior
    - Psychological factors
  - Environmental Information
  - Diagnosis and Treatment Information
  - Public Health
    - Disease surveillance
    - Specific disease management
- NCDS Patients Renal Function Data
- NCDS Patients Carotid Ultrasound Data
Further all-around study

Regional population dynamic health white paper

Real-time visualization platform of disease surveillance

Risk prediction model of priority diseases

High-level scientific research cooperation
Thank you!

致谢

感谢鄞州区CDC、桐乡市CDC的大力支持！