

GEF/UNDP/WHO Pilot Project

Establishing the Early Warning Model of Heat Waves on Health Impacts

Prof. Jin Yinlong

Project Manager of China

**Institute for Environmental Health and
Related Product Safety, China CDC**



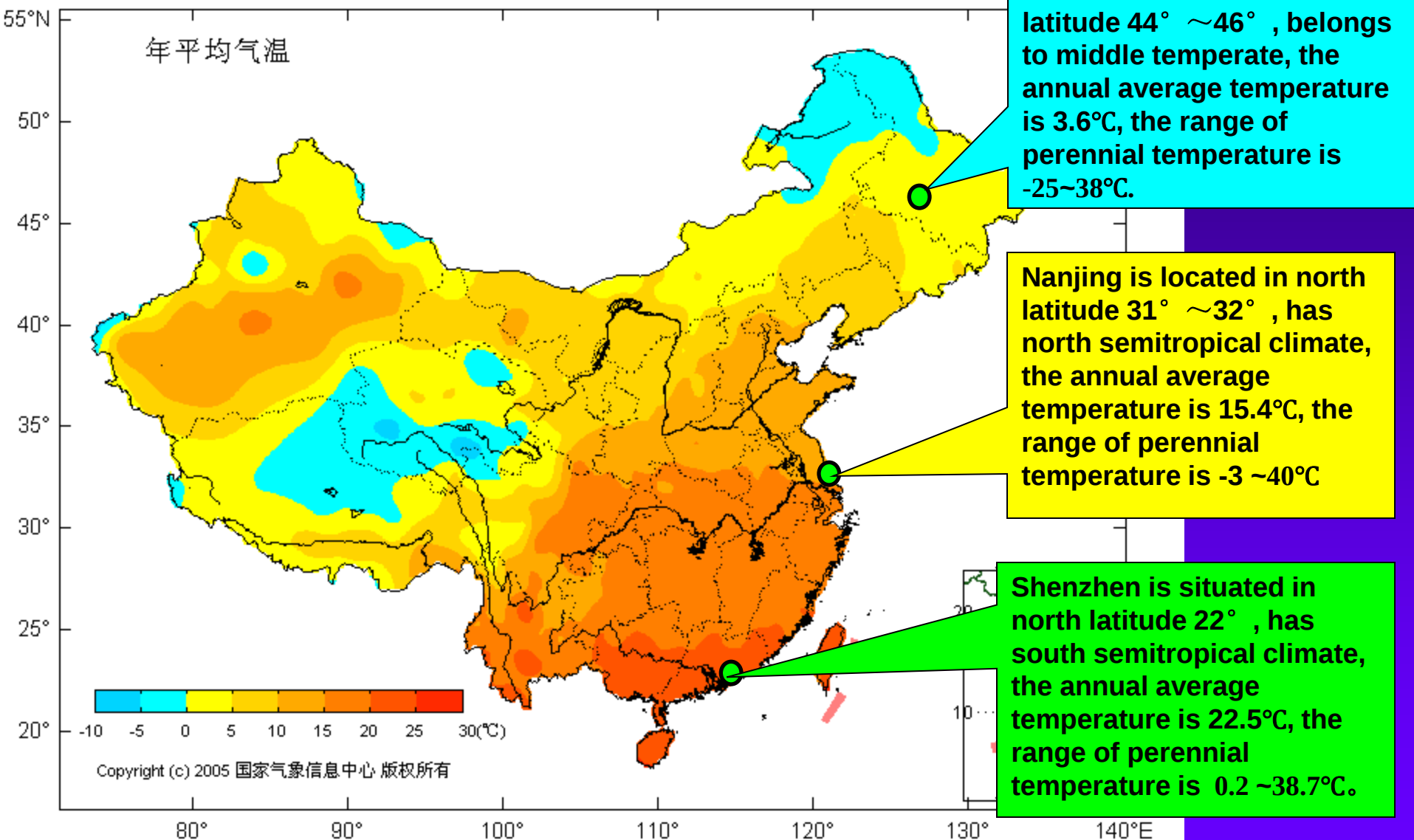
Institute for Environmental Health and Related Product Safety ,China CDC

1. Objectives

- Establishing the early warning model for forecasting the health risks from heat waves for vulnerable population, such as patients with cerebro-cardiovascular diseases.
- Designing a software system for the model and compiling the application guidance for it.



2. Selection of Pilot Cities



3. Selection of Models

- The Health Impact Assessment Model System including the time series Generalized Linear Model (Equation 1) and Proportional Risk Model (Equation 2) were selected as the reference of Early Warning Model of Heat Wave on Health Impacts, which is recommended by WHO and IPCC.



Equation (1)

$$\log[(y_i)] = \alpha + \sum_{i=0}^n \beta_i(X_i) + \sum_{j=0}^m f_j Z_j \quad \text{Equation (1)}$$

↑
Health Outcome
Mortality

↑
Exposure
Temperature

↑
Confounders
Air Pollutants,
Humidity, Seasonal
trend, Day of week
effect

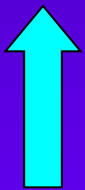
The exposure – response relationship (β) can be calculated by Equation (1).



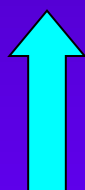
Equation (2)

β value can be obtained from Equation (1) , other parameters can be obtained from survey data, then the additional deaths can be calculated by Equation (2).

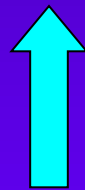
$$\Delta cases = POP \times I_{ref} \times \beta \times \Delta C \quad \text{Equation (2)}$$



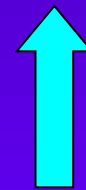
Additional deaths



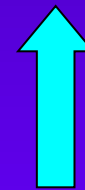
Population



Baseline
mortality
Rate



Exposure-
response
relationship



Temperature



4. Data Collection for Early Warning Model

➤ Exposure

Daily temperature data during 2006 to 2010 in Harbin, Nanjing and Shenzhen, from local meteorological bureau

➤ Health Response

Daily mortality data during 2006 to 2010 in Harbin, Nanjing and Shenzhen, from local CDC

➤ Confounders

Data of daily air pollutants (SO_2 , NO_2 , PM_{10}) and daily humidity during 2006 to 2010 in Harbin, Nanjing and Shenzhen, from local EPA and meteorological bureau respectively.

➤ Other Parameters

Yearly population and baseline mortality rate (average value) during 2006 to 2010 in Harbin, Nanjing and Shenzhen, from local CDC.



5. Pilot establishment of Early Warning Model

Taking model of pilot establishment of Nangang district in Harbin as an example. The quality of mortality data in Nangang district can be ensured, where once was the mortality registration point of WHO.

- Establishment of the model using the data from 2006 to 2010**
- Verification of the model using the data from 2002 to 2005**



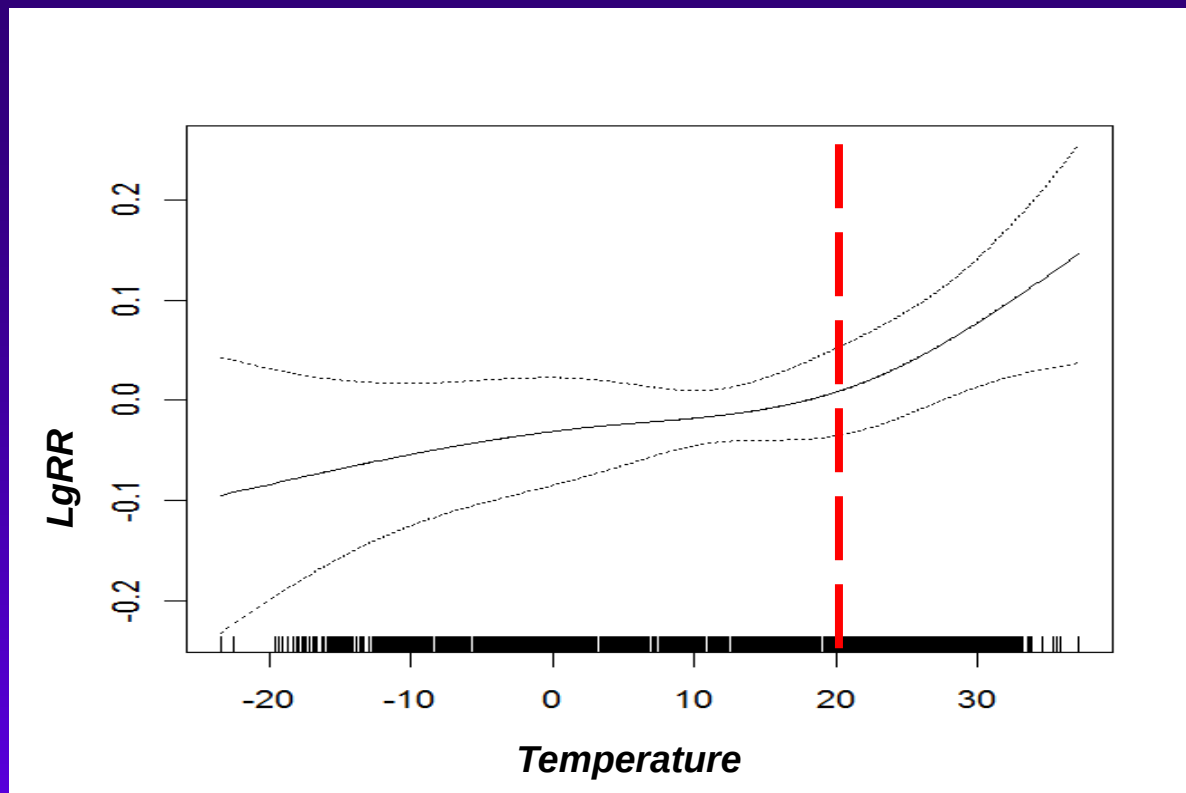


Figure 1. Relationship between temperature and total mortality

Figure 1 shows the relationship between temperature and total mortality. Heat waves early warning model focused on the impacts of high temperature on health. This figure shows the slope increased sharply from 20°C.

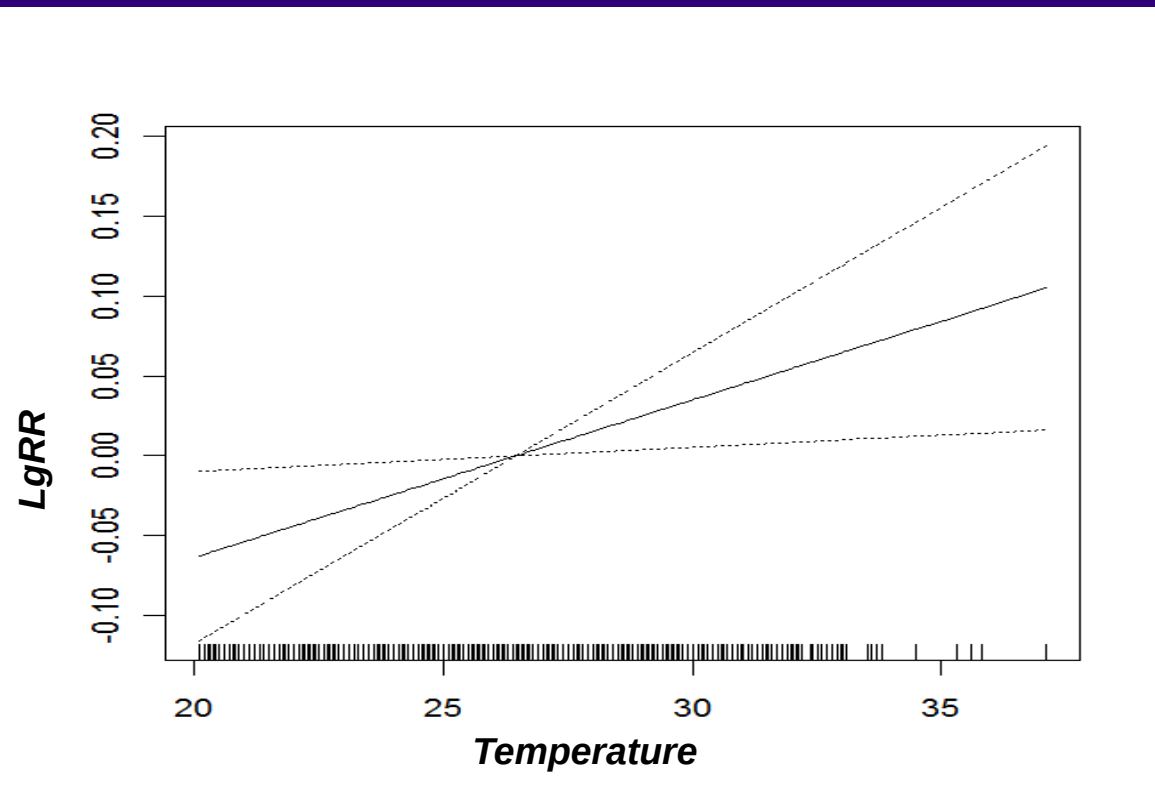


Figure 2. Relationship between temperature above 20 °C and total mortality

Figure 2 was obtained from the temperature data above 20 °C and related mortality, and showed β value is 1.15% per centigrade degree, which means 1.15% of total mortality increasing as increased of 1 °C.

Calculation of Additional Deaths

$$\Delta cases = POP \times I_{ref} \times \beta \times \Delta C$$

990,000 0.6%/365 1.15%/°C

β value, 1.15%, obtained from Figure 2, population (Pop) 990,000, and daily baseline mortality rate (I_{ref}) 0.6%/365, from survey data collected from Nangang District. Predicted additional deaths at more than 20°C can be calculated as the right table:

Temperature value Above 20°C	Additional Deaths
21	0.2
22	0.4
23	0.6
24	0.7
25	0.9
26	1
27	1.3
28	1.5
29	1.7
30	1.8



Verification of the Model

Five target temperature, 25, 26, 28, 28, 30 °C were selected based on the daily temperature more than 20 °C appearing more than 2 times during 2002 -2005, the average daily death number and predicted death number at each target temperature were showed as following table :

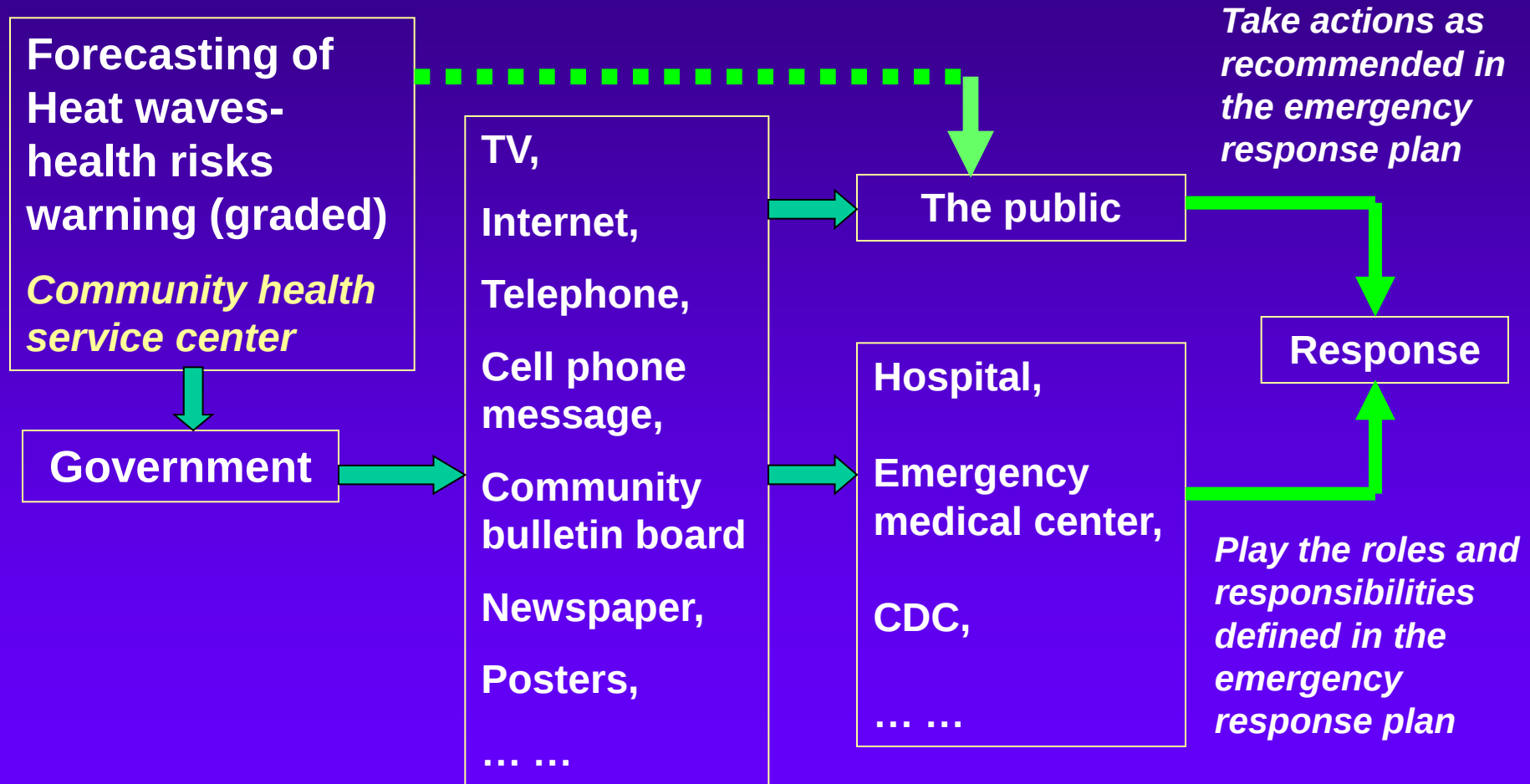
Comparison of predicted number of deaths and observed number of deaths

Target Temperature	Predicted Number of Deaths	Observed Number of Deaths
25	12.9	12.7 (n=3)
26	13	9.7 (n=6)
27	13.3	12.5 (n=6)
28	13.4	13.5 (n=3)
30	13.8	14.3 (n=4)

The correlation coefficient (R) of predicted and observed number of deaths is **0.71**.



Early Warning and Response Systems



Challenges

- **The mortality data is not easy to be checked.**
- **The mortality registration system in China is still improving.**



An aerial photograph of the Great Wall of China, showing the stone wall and watchtowers snaking across verdant, mountainous terrain. The wall stretches from the foreground into the distance, disappearing into the hazy blue mountains. The sky is a clear, pale blue.

Thank you