



Extreme Temperatures :  
Health Impacts and Adaptation  
In Taiwan

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Modifying Influence

Environment Condition

Social Condition

Health System Condition



Climate Change

Health Impact

Climate  
Weather  
Public Health

2016 TSCUP WORKSHOP

Behavioural  
Control

Skin Temperature  
32-37°C

$T_{\text{skin}} - T_{\text{amb}}$

Radiation

Conduction

Convection

Evaporation  
(Sweating)

Ambient  
Temperature

Core Temperature  
36.3-37.1°C

Medical and Behavioural factors  
affecting human thermoregulation  
and the Risk of Heat Illness

2016 WARRKES HOSP

## Factors affecting behaviour

- Physical cognitive impairment
- Psychiatric illness
- Infants

## Increased heat gain

- Exercise
- Outdoor activity
- Medication

## Factors influencing cardiac output

- Cardiovascular diseases
- Medication

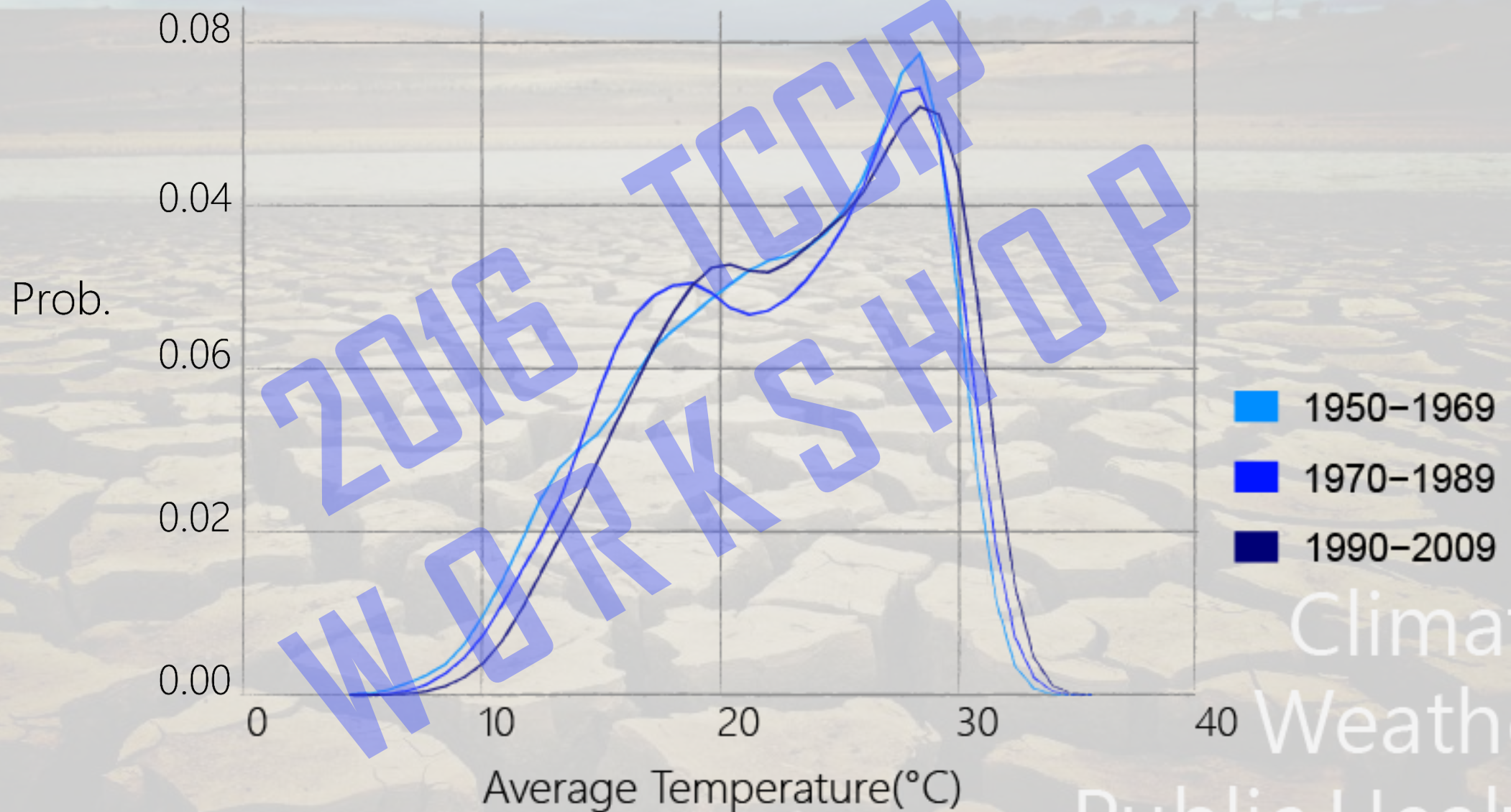
## Factors reducing plasma volume

- Diarrhoea
- Pre-existing renal or metabolic
- Medications

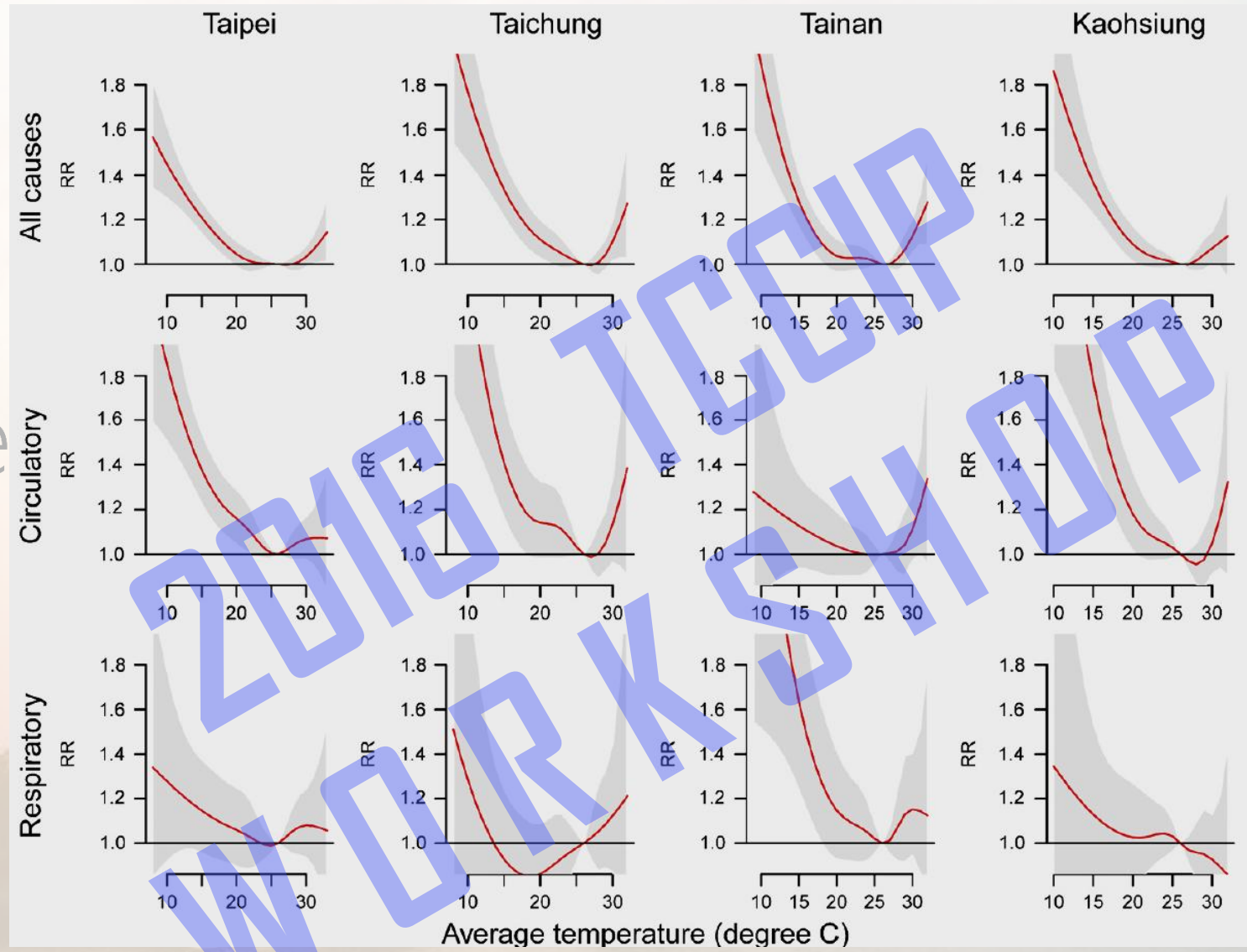
## Factors affecting sweating

- Dehydration
- Ageing
- Diabetes, Scleroderma
- Cystic fibrosis
- Medications

# Taipei



Climate  
Weather  
Public Health



TP

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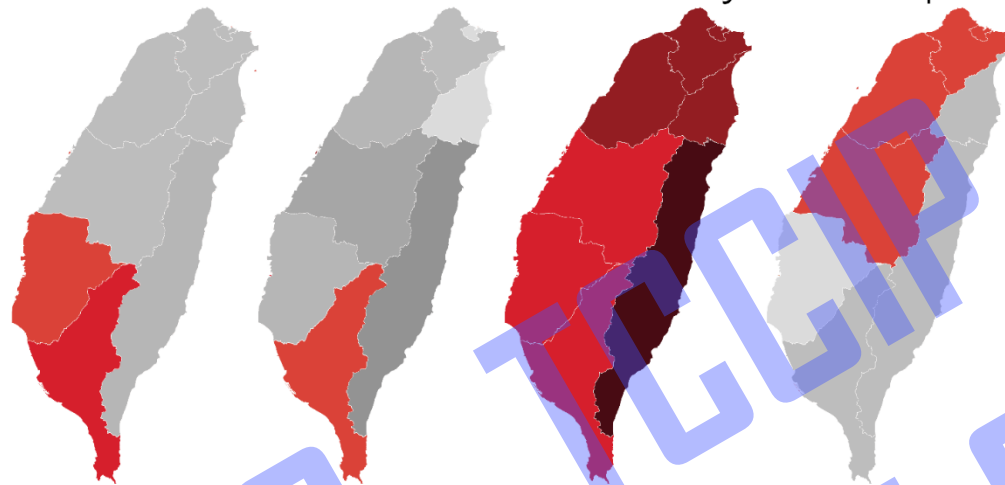
All Causes

CVD

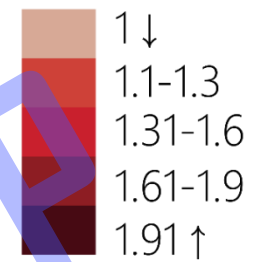
Kidney

Respiratory

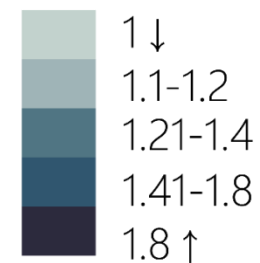
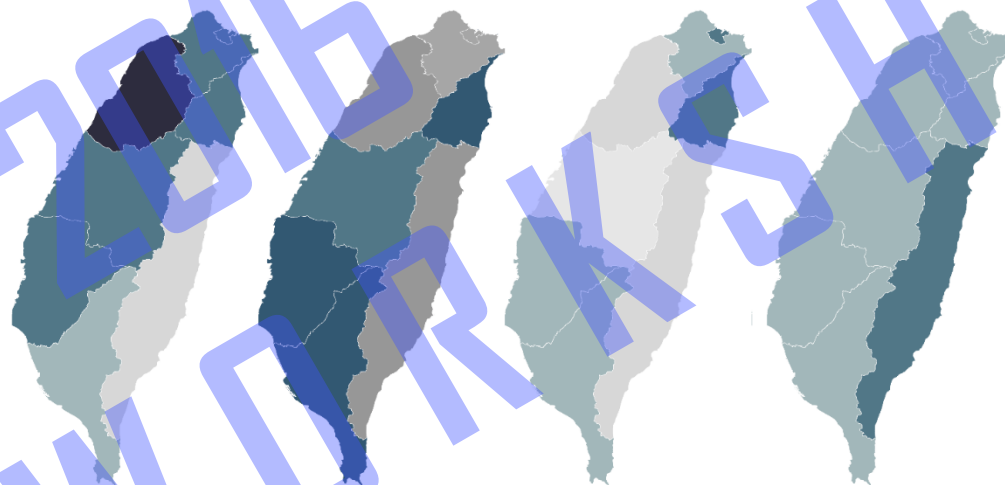
High  
Temp



Relative Risk



Low  
Temp



Climate  
Change

Status  
quo

Natural  
Environment

societal  
Environment

Exposure

Sensitivity

Potential  
Impact

Adaptive  
Capacity

Vulnerability

Adaptation

2016 TCCIP  
AWORKSHOP



# Adaptations of Public Health to Climate Change

2016 IPCC  
WORKSHOP

# Types of climate information relevant for health Decision-Making

Time Scale	Example Climate Information Products	Example application areas
Long Range Climate information (decades)	Climate change scenarios Dynamic climate models, Global Circulation Models	Long term health infrastructure investments, research, demographic/population models, health systems planning Increase understanding of disease trends, epidemic behaviour on a regional scale
Mid-term Climate information (annual to multi-year)	Status of El Nino Inter-annual forecasts Dynamic climate models	Mid-term policy decisions for disease control, research
Short-Term Climate Information (Decadal, Monthly, Seasonal, Annual)	Risk indexes of Cyclones, Floods, Dust Storm, Wind Storms, Extreme Temperature, Fire Temperature/precipitation Outlooks of (6, 3, 1 month) average, maximum and minimum Seasonal trends Tercile forecasts Dynamic and Statistical climate models	Short term operational investment in preparedness, outbreak prevention, resource needs Example, adaptation of WHO/national response plans based on El Nino/La Nina forecasts
Weather Information (Hourly, Daily, Weekly)	Daily Weather: temperature, precipitation, humidity, etc Weather statistics: real-time monitoring, historic time-series, summary statistics	Short term operational decisions Risk announcements, trigger response plans, staff placement, delivery of supplies

# Early Warning Systems

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**Real-time Extreme Temperatures  
Warning System** in metropolitan Taipei

**Mortality risk and dengue fever epidemics**  
based on **seasonal climate outlook**  
in metropolitan Kaohsiung

# Early Warning Systems

## Real-time Extreme Temperatures Warning System

台北市 - 總統府

9°C

多雲 · 降雨機率 0% · 溫度攝氏9度 · 非常寒冷 · 東北風 平均風速1至2級(每秒3公尺) · 相對濕度為63% ·

寒流影響，天氣寒冷，注意禦寒保暖。今天(24日)受寒流南下影響，本市各區的低溫都降到4度以下，在大台北地區不少地勢較高的地區都傳出了下雪或是降下冰霰的消息；臺北站測得的高溫為7.6度，低溫為4.0度。明天(25日)在寒流持續的影響下，本市各區依然寒冷，整天的氣溫約3到10度；天氣方面，因為水氣逐漸減少，將以多雲為主；提醒大家務必注意禦寒保暖，特別是家中有心血管疾病、老人及幼兒請注意氣溫的變化，使用瓦斯熱水器及電暖器時應注意室內通風及用電安全。另外，此次寒流伴隨強烈東北風影響，臺灣各地及綠島、蘭嶼、澎湖、金門、馬祖空曠地區及鄰近海域都有強陣風，在沿海及海上活動的朋友請注意安全，而在強風吹拂下感受將會更加寒冷，請濱海活動的朋友添加防風衣物禦寒。

最後更新時間: 2016-01-25 11:00:00

訂閱警訊通知

# Advice on preventing temperature-related illness

Vulnerable population

Keep out of the heat

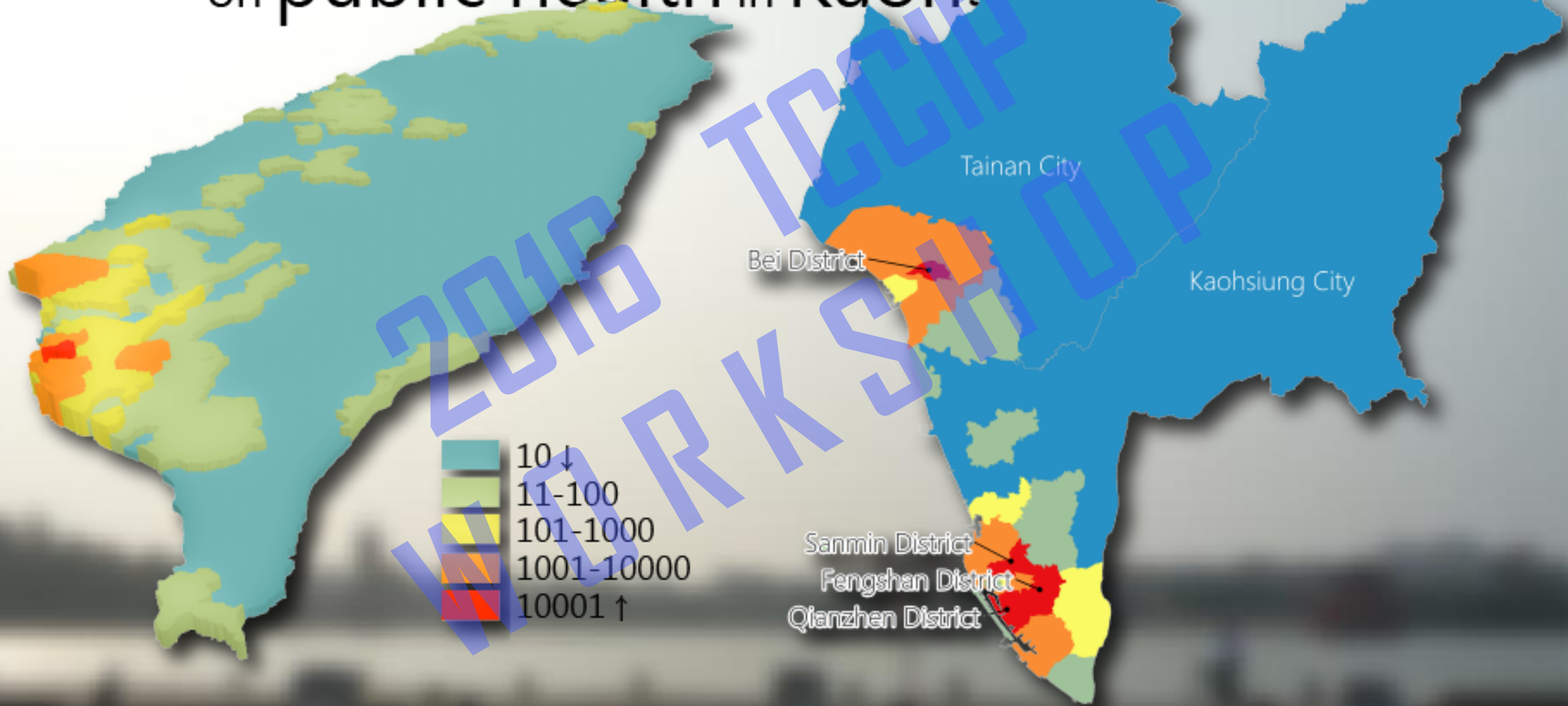
Advice on food, drinks and nutrition

Personal behavior

Advice on medical service

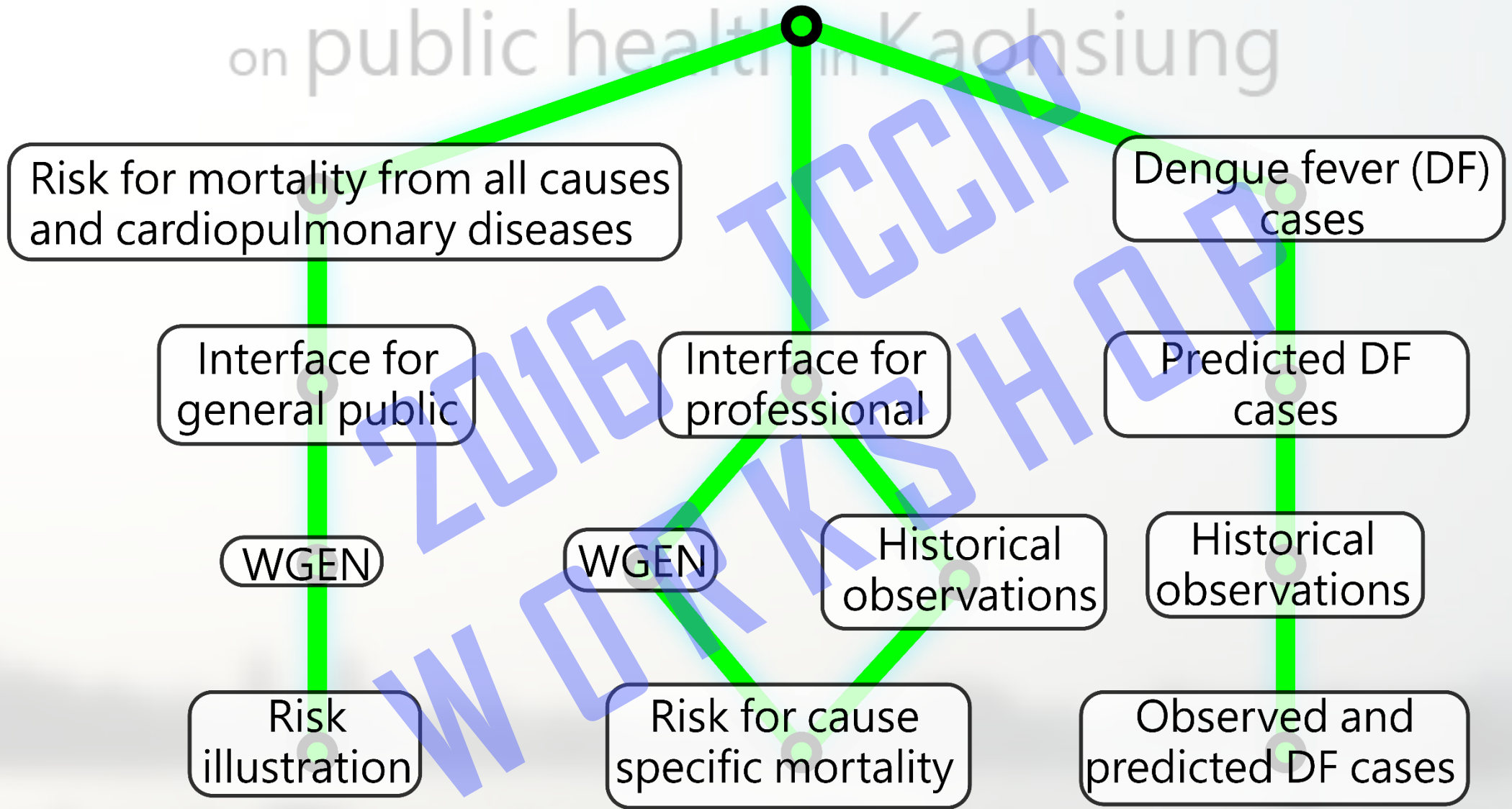
Helping others

# Application of seasonal climate outlook on public health in Kaohsiung



# Application of seasonal climate outlook on public health in Kaohsiung

## START



Central Weather Bureau

# Climate and Public Health

Integrated Services System

2016 TECH  
WORKSHOP



高雄地區慢性病健康風險與建議

應用氣候預報資訊預測高雄地區慢性  
性病健康風險

應用氣候預報資訊預測高雄地區登  
革熱通報病例

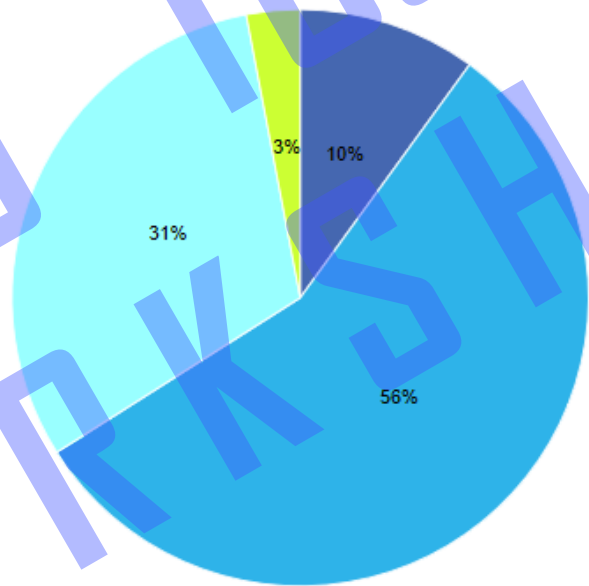
最大機率法則設定

1月

計算結果

冷季(11~4月) ■寒冷危險(< 17°C) ■嚴重警戒(17 ~ 20°C) ■警戒預備(20 ~ 23°C) ■安全(> 23°C)

10% 56% 31% 3%



預警建議 極端溫度預警系統

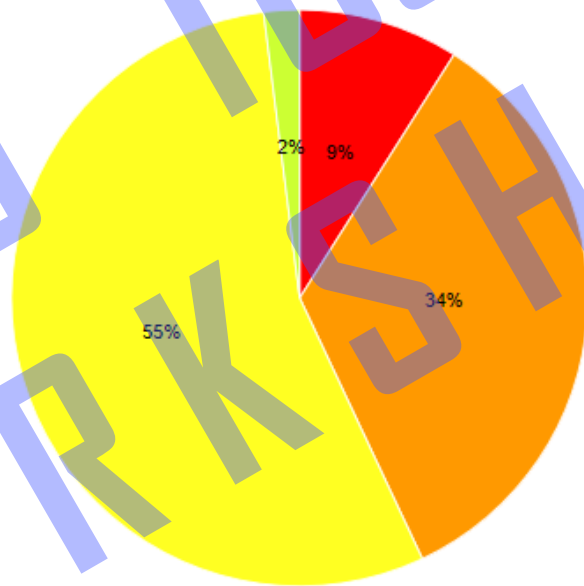
最大機率法則設定

7月

計算結果

熱季(5~10月) ■ 高溫危險( $\geq 31^{\circ}\text{C}$ ) ■ 嚴重警戒( $29.5 \sim 31^{\circ}\text{C}$ ) ■ 警戒預備( $28 \sim 29.5^{\circ}\text{C}$ ) ■ 安全( $< 28^{\circ}\text{C}$ )

9% 34% 55% 2%



預警建議 極端溫度預警系統

月	溫度	機率(%)	次數	全死因	心血管疾病死因	呼吸道疾病就醫
Feb	14	0.25	7	1.370 (1.352~1.389)	1.747 (1.694~1.802)	1.580 (1.576~1.584)
Feb	15	0.893	25	1.330 (1.315~1.344)	1.669 (1.629~1.711)	1.544 (1.541~1.547)
Feb	16	2.036	57	1.291 (1.128~1.301)	1.596 (1.565~1.626)	1.508 (1.506~1.510)
Feb	17	4.786	134	1.254 (1.245~1.262)	1.525 (1.503~1.548)	1.471 (1.469~1.473)

額外死亡或就醫風險=(1-相對風險) x 100%

$\mu=21 \sigma=3$



高雄地區慢性病健康風險與建議

應用氣候預報資訊預測高雄地區慢性  
性病健康風險

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革熱通報病例

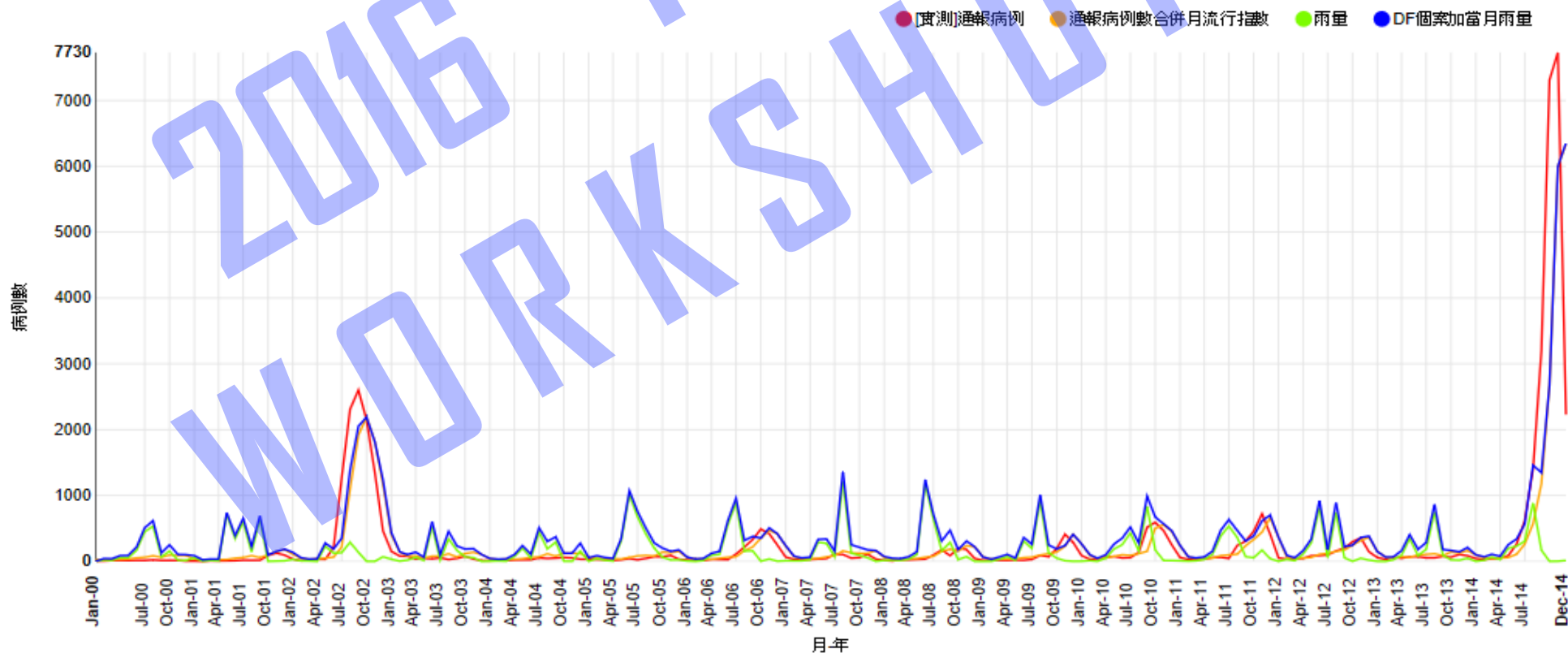
圖表範圍

2000-01-01

2014-12-01

顯示資料

日期	[實測]通報病例	通報病例數合併月流行指數	雨量	DF個案加當月雨量
2014/12/01	2223	6,338.34	13.28	6,351.49
2014/11/01	7730	5,998.23	1.48	5,999.58
2014/10/01	7312	2,673.89	0.00	2,673.76
2014/09/01	3199	1,177.94	169.25	1,347.05



高雄地區慢性病健康風險與建議

應用氣候預報資訊預測高雄地區慢性  
病健康風險

應用氣候預報資訊預測高雄地區登革  
熱通報病例

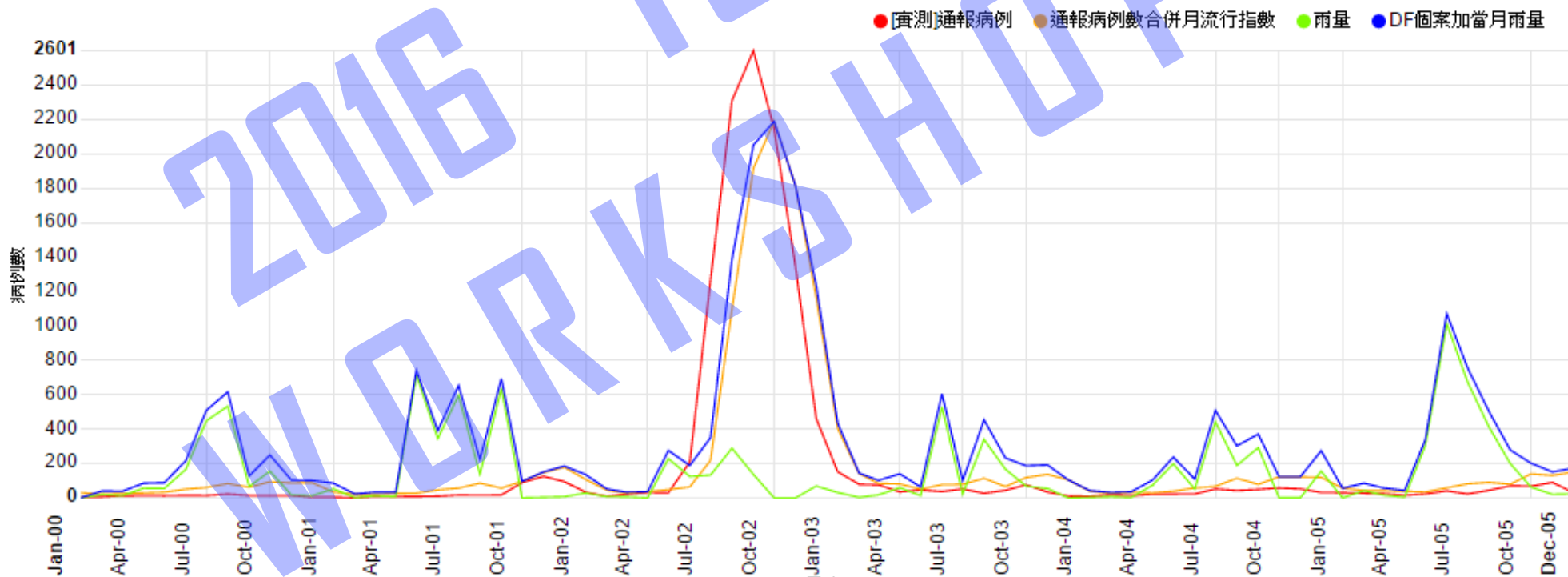
圖表範圍

2000-01-01

2005-12-01

顯示資料

日期	[實測]通報病例	通報病例數合併月流行指數	雨量	DF個案加當月雨量
2005/12/01	32	149.94	23.12	172.93
2005/11/01	90	130.59	20.66	151.13



Central Weather Bureau

# Climate and Public Health

Integrated Services System

- Web :

<http://cwb.etws.tw/>

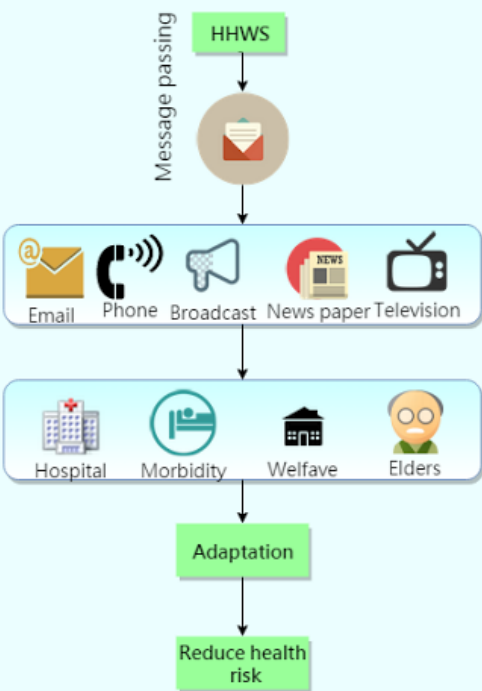
- QR code :



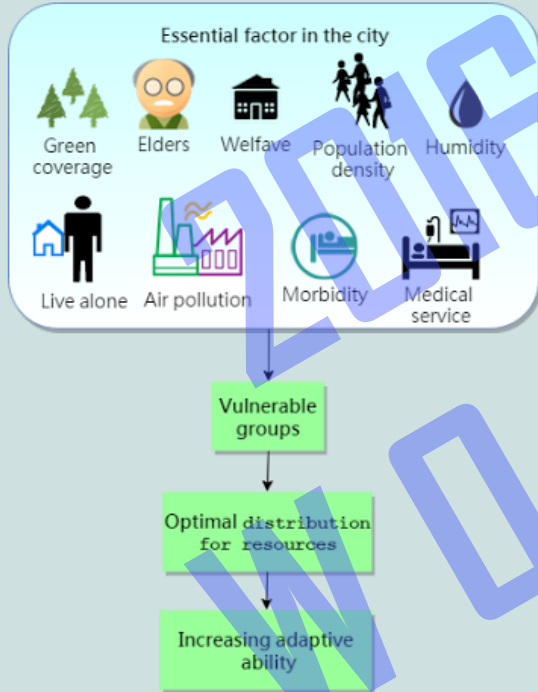
# Future works

## Regional Adaptation plans to Heatwave

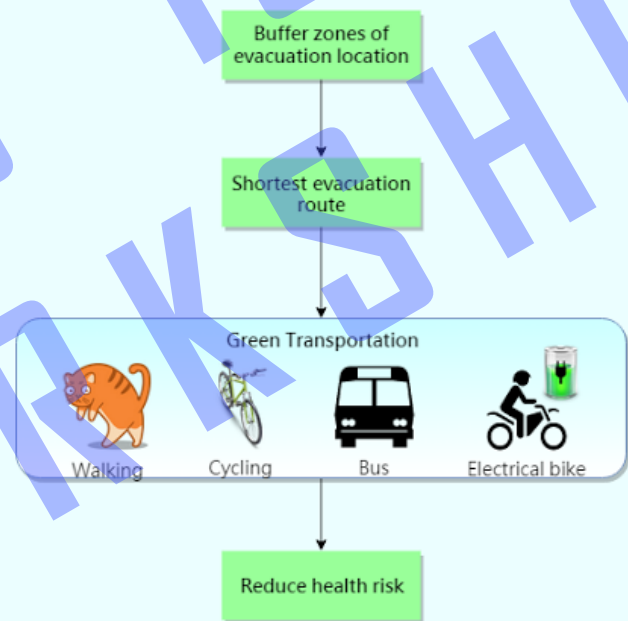
### Warning System



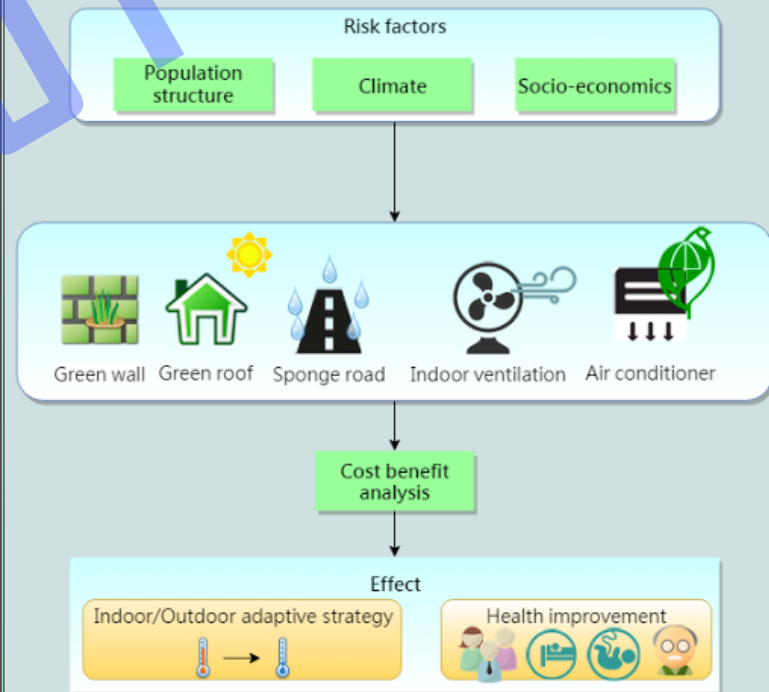
### Spatial risk analysis



### Optimal refuge strategy



### Green building & infrastructure improvement



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**Thank you!**