Chapter 6
Cost-Benefit Analysis for China’s Influenza A (H1N1) Prevention and Control

6.1 The Basic Framework for Cost-Benefit Analysis

6.1.1 Overarching Ideas for Cost-Benefit Analysis

The impact of a public health emergency on a society and economy depends upon two factors: one is the harmful nature of the event along with its duration, and the other is the effect of the social response and measures. Both of these factors are wrought with uncertainty. Firstly, the nature of the event itself is uncertain, for example there may be a lack of understanding regarding the virulence of the epidemic. Secondly, different intervention measures bring about varying uncertainties, such as the use of health campaigning measures to change people’s actions in an epidemic and potentially reduce the number of infected cases.

In order to illustrate this problem, we constructed a decision matrix in Table 6.1. When facing the spread of a known infectious disease, decision makers will adopt “relaxed” or “strict” countermeasures based upon the virulence of the virus or bacteria, so that the measures match the losses. The final results of this decision could be A (minimal cost, minimal losses), or D (high costs, minimal losses). However, when dealing with an unknown infectious disease, such as SARS and Influenza A (H1N1), decision makers are faced with a much more difficult task. If the virus is virulent, but the measures adopted are “relaxed,” then the result will be B: low cost for response measures but high losses. If the virus is more mild, but the measures adopted are “strict,” then the result will be C: minimal losses but high costs. Because epidemics with unknown infectious diseases pose a potential threat to the lives of their citizens, different countries normally will lean towards adopting “strict” measures, which avoids Result B: minimal cost but high losses. If Result C occurs, the high cost can be understood as a type of insurance against the potential
worst case scenario\textsuperscript{1}; however, normally a cost-benefit analysis does not take into account the benefit of paying out this high amount as a type of insurance against the worst-case scenario.

In this Chapter, we will perform a cost-benefit analysis on the prevention and control measures adopted at that time and calculate the costs and net social earnings of the national Influenza A (H1N1) prevention and control efforts. We will also estimate the social and economic benefits generated from these measures. The overarching ideas behind this Chapter’s cost-benefit analysis are as follows: we will compare the difference in results by adopting or not adopting certain response measures in order to estimate the overall net benefit of the measures adopted; if the investment cost from those specific measures is less than the overall loss that could’ve occurred without those measures, then the net social benefits for those measures outweigh the costs. And vice versa would be the net social costs outweigh the benefits of the response efforts. However; we mustn’t forget that this cost could be a type of insurance in preventing a worst-case scenario from occurring.

For the total social costs, we estimated the direct and indirect costs from government departments, public institutions, enterprises, social groups, and individuals in the Influenza A (H1N1) prevention and control efforts.

For the total social benefits, we considered the direct and indirect economic and social benefits from the adoption of these measures and the prevention of more Influenza A (H1N1) cases.

\textbf{6.1.2 Cost-Benefit Analysis Index System}

\textbf{6.1.2.1 Total Social Costs Indicators and Calculation Methods}

Indicators for Total Social Cost

We took into consideration both direct and indirect costs incurred in the prevention and control efforts for calculating total social cost. Direct costs mainly include entry/exit quarantine and inspection investment, isolation costs for close contacts of Influenza A (H1N1), inoculation development and storage costs, the China CDC testing and educational training costs, prevention and control investment by the education system, hospital diagnostic costs, and development and treatment costs of Chinese traditional medicine. Indirect costs mainly include social and economic loss due to loss of work from being infected with Influenza A (H1N1) and healthcare manpower costs. The major indicators can be found in Table 6.2.

\textsuperscript{1}A prime example would be the U.S. government’s decision in facing the 1976 Swine Flu virus.
Calculation Methods

For the national cost estimation for each category, we took the investment by each sampled agency and the number of targets for the prevention and control measures to calculate the average investment per person. Then we took this amount and multiplied it by the total population, which is the estimated value for the national cost. Of course, we also recognize that this estimation inevitably has its limitations due to the choice of sample provinces and the unbalance between regions.

### 6.1.2.2 Indicators for Total Social Benefits

For the total social benefit, we calculated the direct economic benefits and the social benefits from the implementation of these prevention and control measures.

Direct economic benefits include: one is estimating the amount of cases that could’ve occurred without the implementation of the prevention and control measures along with the investment that came from treatment and loss of work; second is estimating the amount of cases that were prevented from inoculating the population, and the investments that came from treatment and loss of work.

For other social benefits, we measured the impact of the prevention and control efforts on the nation’s image, the disease prevention and control capabilities, the credibility of the government, and the protection of National Day celebrations. As some of these benefits are difficult to quantify, we utilized qualitative measures to analyze them.

### 6.2 Cost Estimation for Prevention and Control Efforts Against Influenza A (H1N1)

#### 6.2.1 Direct Cost Estimations

#### 6.2.1.1 Cost Estimations for Inspection and Quarantine Agencies

As of the end of December 2009, the investment ratio for prevention and control efforts by sampled inspection and quarantine agencies is illustrated in Fig. 6.1. Equipment made up the principal amount of the investment at 43.9%, with labor
### Table 6.2 Cost indicators and calculations for Influenza A (H1N1) prevention and control

| Cost type                                      | Measured indicator                                                                 | National cost calculation method                                                                 |
|-----------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Direct costs                                   | Investment from sampled inspection and quarantine agencies                          | Average investment for prevention and control for each entry X total number of entries              |
|                                               | Equipment investment, labor costs, protective equipment costs, health campaign and training costs, etc |                                                                                                   |
| Tracking, isolation, and medical observation costs for close contacts | Centralized isolation costs                                                      | Average cost for tracking and centralized isolation for one case X number of cases in centralized isolation + average cost for at home tracking and isolation X number of cases isolated at home |
|                                               | Health campaign costs, epidemiological investigative costs, transportation costs for close contacts, material costs, accommodation, meals and daily expenses of close contacts, labor costs, etc |                                                                                                   |
|                                               | At home isolation costs                                                            | Use the ratio of at home versus centrally isolated confirmed cases to calculate number of isolated cases |
|                                               | Health campaign expenses (costs incurred using SMS, telephone, etc. to find close contacts) Materials (disinfectants, protective equipment, and other consumable materials); labor costs; etc |                                                                                                   |
| Inoculation costs                              | Inoculation costs                                                                  | Cost of one completed dose X number of people already inoculated + storage cost of one dose X total number of vaccines stored |
|                                               | Vaccine purchase costs; matching injection needle costs; labor costs; printed material costs; emergency medicine and facilities costs; etc |                                                                                                   |
|                                               | Vaccine storage costs                                                             |                                                                                                   |
| Material supporting investment                 | Material stockpiling costs                                                         | Investment in material stockpiling by central and local governments                               |
|                                               | Production investment by enterprises for stockpiling pharmaceuticals, stockpiling costs for treatment drugs |                                                                                                   |
| Investment by the China CDC                    | Virologic detection costs                                                          | Cost for one virologic test X total number of domestic virologic tests                             |
|                                               | Laboratory construction costs, reagent supplies costs                               |                                                                                                   |
| Health education                               | Health education costs                                                             | (Health education investment costs per 10,000 people at the provincial level X same costs per... |

(continued)
| Cost type                              | Measured indicator                                                                 | National cost calculation method                                                                                                                                 |
|---------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| and training costs                    |                                                                                     | 10,000 people at the municipal level + same costs per 10,000 people at the county level X total population (10,000 people)                                                                          |
| Other activities                      | Influenza monitoring investments, epidemiological survey costs                        |                                                                 awards and control investment per sampled school X total number of students in the country X coefficient of correction (ratio of schools affected by epidemic) |
| Investment by the educational system  | Disinfectant and protective equipment costs, equipment purchasing costs, overtime fees, training costs, health campaign costs | Average prevention and control investment in onecase X total number of hospitalized cases in the country                                                                                     |
| Diagnostic investment by hospitals    | Cost of treatment for a case: treatment costs for suspected, mild, severe, critical and death cases | Treatment costs for all types of cases X total number of cases                                                                                                                                      |
|                                       | Hospital influenza A (H1N1) prevention and control investment: new influenza control equipment investment and ward transformation and supporting facilities costs; experts and labor costs; Tamiflu and other drug purchasing costs, protection and disinfection expenditures, etc. | Average hospital investment in one case X total number of hospitalized cases in the country                                                                                     |
| Indirect costs                        | Treatment costs for non-hospitalized confirmed cases                                 | Treatment costs for non-hospitalized patients X (total number of cases in the country — hospitalized patients)                                                                                      |
| Labor costs from missed work of patients with latent infections | Patients with latent Influenza A (H1N1) infections on average missed 7 days of work, and by deducting that from their future income the resulting loss can be calculated | Number of patients with latent infections X average social daily wage X 7 days                                                                                                                      |
| Nursing labor costs for infected patients | On average, each patient with a latent case of the virus needed the care of 0.5 nurse and would miss 3 days of work, deducting that | Number of patients with latent infections X 0.5 nurse X average social daily wage X 3 days                                                                                                           |
| Cost type                                      | Measured indicator                                                                 | National cost calculation method                                                                 |
|----------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Labor costs from missed work of infected patients | From the future income the losses incurred from missing work can be calculated     | Number of hospitalized cases X number of days admitted X average social daily wage                     |
| Nursing cost estimations for infected patients | According to the number of cases and days hospitalized for severe to critically ill patients, deducting that from their future income the losses incurred from missing work can be calculated | Number of patients X 0.5 X average social daily wage X average number of days a person is sick         |

Number of cases X number of days admitted X average social daily wage.
costs (12.3%) and protective equipment costs (10.6%). Other areas such as drug procurement and laboratory construction accounted for nearly one fourth of the total investment.

According to the sampled data, this report highlights the estimations on national prevention and control investment by inspection and quarantine agencies using the eight-year depreciation provision for equipment. The sampled agencies spent 7.84 RMB for each entry into the country, and by December 31st, 2009, 348 million people were reported to have undergone inspection by these agencies upon entry. Therefore, the total cost spent by national inspection and quarantine agencies in prevention and control can be calculated as: $7.84 \times 348$ million people = 2.728 billion RMB.

6.2.1.2 Cost Estimations for Tracking, Isolation, and Medical Observation of Close Contacts

Isolation for close contacts of Influenza A (H1N1) can be divided into two categories: centralized and at-home care. The mean value from the valid sampled data of the evaluation study was used as the reference value, and the average cost for tracking, isolating (centralized), and observing a close contact was 5218.50 RMB. The average cost for tracking, isolating (at-home), and observing of a close contact was 270.80 RMB.

As of August 31st, 2009, 3127 Influenza A (H1N1) cases had been diagnosed across the country, and from September 1st, 2009, to December 31st, 2009, the total number of diagnosed cases reached 116,473.² In accordance with local

²Data from the network for epidemics of the Chinese Disease Prevention and Control Information System.
developments, strict isolation measures for close contacts were in place up until the end of August, and starting the next month, those measures were slowly relaxed. Using August 31st as a marker between two distinct phases on the epidemic, we calculated the ratio of confirmed diagnosed cases with the number of close contact cases that were being isolated (both centralized and home-based) on data from five sampled provinces. We then took this ratio and calculated the total number of isolated close contact cases in the country.

As of August 31st, 2009, the ratio between confirmed cases and isolated contacts stood at 1:10.99. Between September 1st, 2009, and December 31st, 2009, the ratio was 1:0.94.

According to this analysis, the total number of isolated close contacts (both centralized and at-home) was 143,850 people (3127 people $\times$ 10.99 + 116,473 people $\times$ 0.94). The sampled data shows that centrally isolated close contacts accounted for 41.72% of the total number of isolated cases, therefore 600,014 people were isolated in hospitals (centralized) while 83,836 people were isolated at home. The total calculated isolation cost for the country was 335 million RMB.

### 6.2.1.3 Cost Estimations for Influenza A (H1N1) Vaccinations

From September 2nd, 2009, to April 1st, 2010, a total of 795 batches with 151,546,000 doses of the vaccine were issued, with the government storing 26 million doses and distributing the remainder to all the regions. A total of 102 million doses were administered. According to sampled data, it cost 27.43 RMB per vaccine dose, in addition to 21.22 RMB for storage costs, which amounted to 3.849 billion RMB in national vaccine investment.

### 6.2.1.4 Cost Estimations for Material Stockpiling

Due to the large investment gap of local governments between provinces, cities, and counties (as each area’s financial and epidemic situations varied greatly), it is difficult to rely upon survey data to estimate the national average of investment in material stockpiling. According to existing data, pharmaceutical stockpiling companies invested 105.26 million RMB into production, and by December 22nd, 2009, there were 20.8 million doses of Tamiflu within the national stockpile, with the capacity to produce 5.2 million more doses Tamiflu intermediates. There were also 200 thousand doses of the antiviral drug “Zanamivir” that were imported for emergency use. For example, Beijing had three million doses of Tamiflu in reserve, and Sichuan province invested ten million RMB in its medical stockpiling efforts. In the absence of sufficient data, the 1.085 billion RMB from the Material

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3Data derived from the Material Management Group of the Prevention and Control Mechanism.

4See Footnote 3.
Management Group of the Prevention and Control Mechanism was used as data in this study. However, it was discovered in in-depth interviews that because there was no national stockpiling program in mitigating public health emergencies, provincial level institutions created emergency stockpiles according to their local needs. We discovered that these local stockpiles were poorly planned, costly, and wasteful.

6.2.1.5 Cost Estimations for Prevention and Control Investment for the China CDC

As shown in Fig. 6.2 Investment Structure against Influenza A (H1N1) by surveyed prevention and control agencies in 2009, laboratory construction and the use of reagent supplies constituted the principal amount invested in the prevention and control system, standing at 82% of the total. Health campaigns followed at 5.1%, labor costs at 4.8%, and other costs such as epidemiological surveys (including surveyor costs) and monitoring costs accounted for a total of 8.1%.

Virus Detection Costs

The Influenza A (H1N1) virus is virulent, and the early detection costs are quite high. Additionally, laboratory testing fees differ widely due to the different prices of domestically produced and imported reagent materials. According to sampled data, the average cost for a virology test was 415.80 RMB (including sampling,
transportation, protective gear costs), and the country supplied 418,236 virology
tests. Thus, we can conclude the national cost for all virology tests came to 174
million RMB.

Cost Estimations for Health Education and Training

We performed a cost analysis on the annual investment spent by provinces, cities,
and counties on health education and training. According to sampled data, pro-
vinces spent an annual average of 215.09 RMB per 10,000 people on health
education and training, cities invested 62.89 RMB for the same number of people,
and counties spent 821.42 RMB. By the end of 2008, China’s population stood at
1.32802 billion people (data derived from China Statistical Yearbook 2009). Thus,
the average amount spent nationally for health education and training was 146
million RMB.

Investment Estimations for Laboratory Construction and Other Activities

According to data received on the investment into other activities by the CDC, we
calculated investments estimations for the CDC on Influenza A (H1N1) prevention
and control laboratories. Using the eight-year depreciation provision, we estimate that the total investment in laboratory construction for Influenza A (H1N1) was roughly 832 million RMB.

### 6.2.1.6 Cost Estimations for Prevention and Control of Influenza A (H1N1) in Educational Systems

Based on the data collected from the schools surveyed, the breakdown of different invested costs is shown in the figure below. Among these numbers, disinfectant and protective gear accounted for 23.3% of the total cost, equipment procurement 21.6%, overtime fee 15.8%, training costs 9.6%, health campaign costs 4.5%, and other fees totaled 25.2% (Fig. 6.3). The figure shows that the proportion of other costs are quite high, and from our qualitative analysis we found this was because of the costs incurred by the school in the provision of books, lunches, gifts, and toys given to students when class was suspended. These measures were taken to lessen the social impact of having to stop class. In caring for the students, schools did a lot of innovative work in counseling students and family members, and provided a strong foundation for the smooth development of Influenza A (H1N1) prevention and control efforts.

According to the 2008 Statistical Report from the Ministry of Education, as of December 31st, 2008, there was a total of 320.99 million students in school. From our sampled data, we found that as of December 31st, 2009, the total investment costs sat at 621,309 RMB for 16 schools with a total population of 32,892 students. According to the data above, the average per capita investment on Influenza A (H1N1) in these sampled schools was 18.89 RMB. Considering the sampled schools were chosen because they were affected by the epidemic, we correct our ratio in comparison with the national total investment. According to qualitative interviews and expert consultations from the Ministry of Education and other related prevention and control agencies, we have calculated the correction factor is \( R = 0.76 \). Therefore, the total national investment in schools is estimated to be 3.996 billion RMB.
6.2.1.7 Investment in Hospital Diagnosis and Treatment of Influenza A (H1N1) Cases

Direct Costs for Influenza A (H1N1) Diagnosis and Treatment

We collected 441 samples of suspected, mild, severe, critically ill, and fatal cases of Influenza A (H1N1) from 18 random hospitals and calculated the average cost for different levels of diagnosis and treatment of the virus (Table 6.3).

According to Table 6.3, the national direct cost for diagnosis and treatment was calculated as 159 million RMB.

Investment in Hospital Prevention and Control of Influenza A (H1N1)

As of the end of December in 2009, the total investment of 12 sampled hospitals for their Influenza A (H1N1) prevention and control stood at 149.2544 million RMB. Among that, the government allocated 33.5094 million RMB, accounting for 22.45% of the total investment, and the average amount invested per sampled hospital was 12.438 million RMB. As seen in Fig. 6.4, among the investment amount between the 12 sampled hospitals, new equipment for Influenza A (H1N1) prevention and treatment, ward transformation, and supporting facility construction accounted for almost 70% of the total costs. Expert and labor costs stood at 12.1%, and other costs like Tamiflu procurement, protection and disinfectant expenditures (including patient and specimen transport, publicity and education, and training) only accounted for less than 5%. These numbers are evidence to the fact that procurement of new Influenza A (H1N1) equipment and instruments along with ward construction were the key areas of hospital’s prevention and treatment investments.

A large portion of the capital invested by hospitals in prevention and treatment of the virus went to procurement of equipment and ward transformation. After calculating the eight-year depreciation provision for the equipment used, the average investment for a sampled hospital in prevention and treatment was 50.268
million RMB, with the average amount spent on one hospitalized case at 16,761.6 RMB. Thus, the estimated total for investment by hospitals nationwide comes in at 523 million RMB.

6.2.1.8 Medical Treatment Costs for Diagnosed Patients Outside of the Hospital

According to in-depth interviews and expert assessments from the five sampled provinces, the medical cost for each diagnosed patient outside of the hospital was 450 RMB. Between August 31st, 2009, and December 31st, 2009, there was a total of 116,473 people diagnosed in China with Influenza A (H1N1), and deducting the 31,174 people that were hospitalized, the total cost for medical treatment for patients outside of the hospital totaled at 38 million RMB.

6.2.1.9 Self-medication Costs for Undiagnosed Patients

The number of total diagnosed cases in the country did not effectively represent all the patients suffering from the Acute Respiratory Infection (ARI). Looking at statistics from other countries, we see that it is extremely difficult to identify the exact number of Influenza A (H1N1) cases among all ARI cases. This report assumes that patients suffering the symptoms of Influenza A (H1N1) would likely self-medicate, and the process for estimating undiagnosed patients is as follows: According to the results of serologic tests and expert assessments in 2010, 21.5% of the population tested positive in Influenza A (H1N1) serologic testing. Taking away those that tested positive due to inoculation, a total of 86.7 million people (102 million × 85%), the total number of people infected in China with Influenza A (H1N1) was 198.8243 million people. Taking into account that 2/3 of patients showed symptoms, it is estimated that a total of 132.5495 million people was infected with the virus, and deducting the 116.5 thousand people that were diagnosed between August 31st, 2009, and December 31st, 2009, the total number of people infected with Influenza A (H1N1) that went untreated amounted to 132.433 million people. According to our in-depth interviews and expert analysis, if patients with suspected or confirmed cases of the virus were not showing any symptoms, they didn’t need to be hospitalized, and the medicines used were similar to those taken for the common cold. Doctors normally recommended Banlangen or cold medicine in powder form, and other common antipyretics were also taken. These medications are quite cheap, and the average daily cost of consumption is roughly 10–20 RMB. Experts estimated that as long as the

5Derived from the China CDC monitoring data.
6Zhong Nanshan: Mainland report on number of Influenza A (H1N1) fatalities: “I just don’t believe it.” Guangzhou Daily, November 19, 2009. http://news.ifeng.com/world/special/zhuliugan/zuixinbaodao/200911/1119_6347_1442153.shtml.
condition didn’t worsen, the average cost of care was 200 RMB.\(^7\) According to the phone survey conducted by the China CDC’s Office for Disease Control and Emergency Response after the peak of the epidemic, it was estimated that 45% of people self-medicated and from this estimation we can calculate the total self-medication expenses from undiagnosed patients: \(132,433,000 \times 45\% \times 200\) RMB = 11.919 billion RMB.

### 6.2.2 Indirect Cost Estimations

The population in indirect cost estimations is divided into three groups. One group includes all patients diagnosed as recorded in the web-based reporting system of infectious diseases and undiagnosed individuals (including the expected number of patients due to lack of prevention and control), the second group includes the number of people that avoided the disease thanks to the implementation of effective prevention and control strategies, and the third group includes all healthy people. Missed work time and care costs were calculated for each individual group (Table 6.4).

#### 6.2.2.1 Missed Work Costs for Patients with Influenza A (H1N1) Symptoms

According to in-depth interview data and expert assessments, the total population of patients with Influenza A (H1N1) symptoms that went untreated was 132.433 million, and 1.2% of them have missed work. As there is no data on the exact number of people that missed work across the nation as well as a stipulated national average wage, this study used the wages found in the national compensation law to estimate the cost for missed work time. Article 33 in the *National Compensation Law* stipulates that the daily compensation for infringing upon personal freedoms would be calculated according to the average daily wages of the previous year. Within the *Notice*, data from 2007 collected by the National Bureau of Statistics showed that the average annual salary for an urban worker in a non-private enterprise was

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\(^7\)http://blog.163.com/ch7w_yf005@126/blog/static/12760391920091122102953373/.
32,736 RMB. According to related national statistics, the average daily wage was 125.43 RMB. Thus, the total expense for missing three days of work for patients with Influenza A (H1N1) symptoms was $132,433,000 \times 0.012 \times 125.43 \times 3 = 598$ million RMB.

### 6.2.2.2 Missed Work Costs for Diagnosed and Isolated Patients

To calculate the losses resulted from missing work of Influenza A (H1N1) patients we used the human capital approach to estimate the present value of a person’s future income. Based on the number of hospitalized cases for mildly, severely, and critically ill patients along with the number of days spent in the hospital, discounting future income can be used to calculate losses caused by missing work.

According to Article 33 of the National Compensation Law, the average daily wage was 125.43 RMB. As listed above, the total number of diagnosed Influenza A (H1N1) cases between August 31st, 2009, and December 31st, 2009 stood at 116,473 people, adding to that the estimated number of hospitalized patients (60,014) and patients isolated at home (83,836). If we assume that this group of people missed seven days of work, we can calculate that the indirect economic loss caused by the virus was $(116,473 + 60,014 + 83,836) \times 125.43 \times 7 = 229$ million RMB.

### 6.2.2.3 Nursing Care Costs for Those with Influenza A (H1N1) Symptoms

Data from the five sampled provinces showed that the care of 0.5 nurse was required for each person with the virus symptoms. The average daily wage of 125.43 RMB was used to calculate the financial contribution in a working day, and three days were accounted for the average amount of time for caregiving.

Therefore, nursing care costs were calculated as: $132,433,000 \times 0.012 \times 0.5 \times 125.43 \times 3 \text{ days} = 299$ million RMB.

### 6.2.2.4 Nursing Care Costs for Influenza A (H1N1) Patients

Data from the five sampled provinces showed that 1.5 nursing care was required for each patient. The average daily wage of 125.43 RMB was used to calculate the financial contribution in a working day, and seven days were accounted for the average amount of time for caregiving.

Therefore, nursing care costs were calculated as: $116,473 \text{ people} \times 1.5 \times 125.43 \text{ RMB} \times 7 \text{ days} = 153$ million RMB.
### 6.2.3 Calculations of Total Social Costs

Based on the aforementioned expenses, the rough calculation of the total social cost in the prevention and control of this Influenza A epidemic is found in Table 6.5.

Additionally, since there is a lack of data on the direct and indirect costs of traditional Chinese medicinal uses against the virus, this report is unable to provide any concrete statistics regarding that topic. However, according to the data provided by the National Traditional Chinese Medicine Management Bureau, the costs for using traditional Chinese medicine in treating light to mild cases was much lower than the cost of using Tamiflu and other antiviral drugs. Thus, it is estimated that traditional Chinese medicine had better cost-effectiveness in treating lighter to mild cases of the virus.

#### Table 6.5 Total social cost for Influenza A (H1N1) prevention and control

| Cost type                                                                 | Cost estimation   |
|---------------------------------------------------------------------------|-------------------|
| Direct costs                                                              |                   |
| Investments by inspection and quarantine agencies                          | 2.728 billion RMB |
| Tracking, isolation, and medical observation costs for close contacts      | 335 million RMB   |
| Influenza A (H1N1) vaccination fees                                       | 3.849 billion RMB |
| Material stockpiling costs                                                | 1.085 billion RMB |
| Investments by CDC                                                        | 1.152 billion RMB |
| Investments in the educational system                                      | 3.996 billion RMB |
| Direct costs for diagnosis and treatment for Influenza A (H1N1) cases in hospitals | 159 million RMB   |
| Hospital investment in prevention and control efforts against the virus   | 523 million RMB   |
| Medical expenses for non-hospitalized diagnosed patients                  | 38 million RMB    |
| Self-medication expenses for those with Influenza A (H1N1) symptoms       | 11.919 billion RMB|
| Indirect costs                                                            |                   |
| Missed work costs for those suffering from Influenza A (H1N1) symptoms   | 598 million RMB   |
| Missed work costs for diagnosed and isolated patients                     | 229 million RMB   |
| Nursing care costs for those with Influenza A (H1N1) symptoms             | 299 million RMB   |
| Nursing care costs for Influenza A (H1N1) patients                       | 153 million RMB   |
| Total social cost                                                         | 27.063 billion RMB|
6.3 Benefit Calculation for the Prevention and Control of Influenza A (H1N1)

The start of Influenza A (H1N1) in China occurred at the same time as the U.S. subprime mortgage crisis, which triggered an international financial crisis and negative economic growth. The financial impact of this pandemic globally and domestically was a major concern for both policymakers and researchers alike. In its early stages, the spread of this unknown infectious disease wreaked havoc both economically and socially for countries such as Mexico, the United States, Ukraine, and South Korea. In terms of China, although there were some places that merited concern, it only affected the economy and society to a certain extent. For example, some schools were temporarily closed and certain social activities suspended, but as a whole, there was no serious impact on economic activities. The only areas to suffer were tourism and exhibition type industries. Moreover, the government actually had to increase its investment in areas such as vaccine and medicine production, material stockpiling, and medical treatment provisions, which in some way helped further the development of these industries.

That being said, the worst-case scenario shows us that as soon as another outbreak occurs, or even when prevention and control is lost, quite a bit of damage can be caused to both domestic and international economies. It is evident that China effectively prevented the epidemic from getting out of control, and the state also reduced the impact it could’ve had on GDP. Therefore, the benefits calculated from the prevention and control efforts are divided into three categories: direct economic benefits, indirect economic benefits, and macroeconomic benefits.

6.3.1 Direct Economic Benefits

According to monitoring data by the Chinese Center for Disease Control and Prevention, as of January 2010, 17.1% of the population that had not been inoculated against the virus tested positive in serologic testing for H1N1 antibodies, and only two thirds of patients of Influenza A (H1N1) showed symptoms. Therefore, the incidence of Influenza A (H1N1) among the population of people who had not been inoculated stood at 11.46%. As it is very difficult to acquire statistics on the occurrence of the virus in the natural population, this study used this statistic as the natural occurrence rate.

The literature shows that Mexico, the United Kingdom, and Hong Kong adopted a segmented “compound interest of $R_0$” in their relevant research, but as we were unable to obtain the data needed for such segmented calculation, we believe that in China it is closer to $R_0 = 1.5$ according to our data from five sampled provinces and
expert recommendations from the China CDC. Therefore, the total number of infected individuals with Influenza A (H1N1) in China’s natural population is calculated as: $1,328,020,000 \times 11.46\% \times (1 + 1.5) = 380,477,700$ people.

The prevention and control measures reduced the number of infected individuals with Influenza A (H1N1), and we can calculate it as $380,477,700$ people $– 132,433,000$ people $= 248,044,700$ people. By the end of 2009, there were 31,174 patients hospitalized with Influenza A (H1N1), which accounted for 0.028% of the country’s total number of patients. Therefore, it is estimated that 69,453 people out of 248,044,700 people were hospitalized. With reduced number of patients, the avoided hospital costs totaled: $69,453 \times 4561.5$ RMB $= 3.168$ billion RMB. The total medical costs saved due to the reduction of patients totaled: $(248044700–69453$ people) $\times 45\% \times 200$ RMB $= 22.318$ billion RMB.

### 6.3.2 Indirect Economic Benefits

#### 6.3.2.1 Benefits in Preventing Loss Arising from Medical Leaves

Benefits in Preventing Loss Arising from Medical Leaves of Hospitalized Patients

Based on the fact that effective prevention and control measures prevented the hospitalization of 69,453 people, the average time gone from work was seven days, and the social daily average wage of 125.43 RMB, benefits for preventing loss of work is 61 million RMB ($69,453 \times 7 \times 125.43$ RMB).

#### 6.3.2.2 Benefits in Preventing Loss Arising from Medical Leaves of Non-hospitalized Patients

As effective prevention and control measures also reduced the number of infected individuals to 248,044,700 people, and deducting the estimated 69,453 hospitalized patients, according to the 1.2% of non-hospitalized patients that missed seven days of work, the total amount saved in preventing loss arising from medical leaves of non-hospitalized patients is as follows: $(248044700–69453) \times 1.2\% \times 7 \times 125.43$ RMB $= 2.612$ billion RMB.

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8Fraser et al. Science 2009, Science 19 June 2009: 1557–1561. Published online [https://doi.org/10.1126/science.1176062].
6.3 Benefit Calculation for the Prevention and Control of Influenza A (H1N1)

6.3.2.3 Benefits in Preventing Nursing Care Costs

Based on the fact that successful prevention and control measures prevented 48,543 people from being hospitalized, and because each patient required 1.5 nurses with seven-day care, then according to the average daily wage of 125.43 RMB, the benefits of preventing nursing care costs is totaled at: 91 million RMB (69,453 people × 7 days × 1.5 nurses × 125.43).

From April 25th to December 31st, 2009, prevention and treatment measures for Influenza A (H1N1) is estimated at 1 RMB cost to 0.98 RMB benefit (Table 6.6).

| Estimates | Costs (100 million RMB) | Benefits (100 million RMB) | Benefits/costs |
|-----------|-------------------------|-----------------------------|----------------|
| 253.99    | 250.82                  |                             | 0.98           |

6.3.3 Macroeconomic Benefits

According to the report *Analysis and forecast of the effects of Influenza A (H1N1) on the Chinese economy* by Taoxiong Liu et al., with a moderate outbreak of the virus where it spread through the country to a certain degree and was then effectively controlled, predictive calculations purport that this type of situation affects domestic demand, thus causing a 1.2 percentage point drop in the annual GDP.9

According to annual statistical analysis for 2009 of the primary, secondary and tertiary industries, the only one to be directly affected after the outbreak of the virus was the tertiary industry, as the tourism sector was hit pretty hard. After revising the data in the predictions by Liu et al., we found that after the adoption

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9Taoxiong Liu, Xiaoming Wu. *Analysis and forecast of the effects of Influenza A (H1N1) on the Chinese economy*, 2009.
of prevention and control measures, the outbreak of Influenza A (H1N1) affected GDP by 0.53–0.8%.\(^1\)

Therefore, the cost-benefit analysis with the GDP loss avoided by effective prevention and control measures as social benefits is as follows: when the coefficient of consumer multiplier is 1, the amount of social benefits created is 177.85 billion RMB; when the coefficient of consumer multiplier is 1.5, the amount of social benefits reach 268.28 billion RMB.

From April 25th to December 31st, 2009, prevention and treatment measures for Influenza A (H1N1) at its lowest is estimated at 1 RMB cost to 7.99 RMB benefit, and its highest at 1 RMB cost to 1.5 RMB benefit (Table 6.7).

| Coefficient of consumer multiplier = 1 | Costs (100 million RMB) | Benefits (100 million RMB) | Benefits/costs |
|----------------------------------------|-------------------------|----------------------------|----------------|
| Coefficient of consumer multiplier = 1 | 270.63                  | 2029.32                    | 7.99           |
| Coefficient of consumer multiplier = 1.5 | 270.63                  | 2933.62                    | 10.84          |

\(^1\)The consumer multiplier model is based on the Keynesian theory of economics. It first takes into account the direct effects of the epidemic on consumption, for example tourism, and then through the multiplier application, it also looks into indirect effects on the economy, and together it calculates the total economic impact. After the outbreak of Influenza A (H1N1), the service industries were directly affected, especially tourism. Economists used a multiplier between 2 and 3 in estimating the multiplier effect on domestic tourism. The following analysis is based upon online data and should provide a reasonable speculation and analysis of the entire country’s situation. According to data about visitors from outside China, the numbers show that in the first half of 2009, foreign exchange earnings from tourism dropped 11%, and 122.4 billion RMB was lost. According to last year’s domestic flight and tourism trends along with the decreasing amount of large scale activities or gatherings, a conservative estimate shows a 10% loss in domestic tourism earnings, a loss of up to 56.45 billion RMB. Thus the total loss for both domestic and foreign tourism was up to 178.85 billion RMB. Taking into consideration that the epidemic tapered off in the fourth quarter, this study adopts the following two parameters: First, there is no multiplier effect. The impact totalled 177.85 billion RMB in 2009, China's total GDP was 33.5353 trillion RMB, so the affect accounted for 0.53%; the second is calculated in accordance with the multiplier being 1.5, and the impact was 268.28 billion RMB. In 2009, China's total GDP was 33.5353 trillion RMB, so the affect accounted for 0.8%.