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Scientific instrument allocation optimization in biomedicine field based on economic analysis

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ABSTRACT

Large-scale scientific instruments play an important role to promote the development of biological medicine industry, and a low efficient allocation can seriously hamper the improvement and development of biological medicine industry. This study evaluates the allocation of scientific instrument using economic analysis model and proposes an optimization model using social force model with the research objective of economic losses alleviated after configuring an instrument. The optimization model solves the scarcity of instrument and considers the shortest sharing distance at the same time. We verify its feasibility and effectiveness by application to real calculation, and summarize the shortcomings and directions of future studies.

KEYWORDS

Large-scale scientific instruments; Allocation; Optimization; Economic analysis.

INTRODUCTION

Biomedicine industry is a sunrise industry with promising future. And China is a big competitor in this area. Recent years, Chinese government encourages and strongly supports the biomedicine enterprises to inventnew products. All of these innovation activities need a large number of scientific experiments. According to the rough estimation, there are nearly 9500 sets of scientific instrumentswhose unit cost over￥500,000. And the total cost of these instrumentsis more than 12 billion. But the government always focuses on ROI of the instrument investment, ignores the management of these instruments. For instance, some of them are overburdened, and some of them are left unused. National ministry of science and technology and ministry of finance have noticed the unreasonable allocation of the scientific instruments. In 2008, they carried out an investigation about the usage of large-scale scientific instruments, experiment labs and biological species resources in the colleges and government owned research institutes[1]. Based on the research, the large-scale scientific instrument's utilization and sharing status report was published. This paper analyzed the instruments allocation in China from economic perspective. Then proposed an instrument allocation plan based on this analysis result. This plan aims to make the instruments allocation more reasonable.

OVERVIEW OF SCIENTIFIC INSTRUMENT IN BIOMEDICINE FIELD

Definition of biomedicine

Generalized biomedicine refers to the technology of combining modern biotechnology with various forms of research, development and production of new drugs and with the diagnosis, prevention and treatment of various diseases[2]. The narrow sense of biomedicine refers firstly to researching and developing new vaccine, diagnosis reagent and biotechnology drugs to prevent, diagnosis and treat diseases, which serious threat to human life and health, such as malignant tumor, cerebrovascular disease, nervous system disease, digestive system disease, AIDS and HIV under the background of life science and biotechnology stepping into the genome era; secondly to developing new formulations of existing biotechnology products, including paint, suppository, aerosol, drops and so on; thirdly to identifying and researching new drug, target gene or target protein, using the method of functional genetics; lastly to new process and technology of constructing new strains or producing strains of new antibiotics, vitamins, amino acids and other products to improve the fermentation level and reduce consumption using recombinant DNA technology and protoplast fusion technique[3]. Study on the biomedicine field in this paper is generalized, so the scientific instruments in biomedicine field refer to the instruments used to research and develop new drugs by using biotechnology. This paper mainly study the scientific instruments used in biomedicine area whose value is more than ￥500,000.

Development of biomedicine

Modern biotechnology originated in America. It is the first country to research and develop new drugs using biotechnology. In 1971, the world's first biopharmaceutical company was born in America. The company has officially put more than 40 bioengineering drugs on the market, which are widely used in treating cancer, anemia, hepatitis, heart failure and other major diseases. Japan developed a "biological industry country" strategy, thus have certain achievements in biotechnology field. Indian government established a special department to support biotechnology and planned to use $65,000,000 each year for biotechnology researches[4].

Although research and development of biomedicine starts relatively late in China that the China food and drug administration (CFDA) approved the first domestic genetic engineering drug at 1989, biomedicine industry got a rapid development which should credit to good national industrial policy. The biomedicine industry has served as a new core industry and China has become the world's fifth largest biopharmaceutical market, showing rapid growth.

With the development of biomedicine, the world is paying more and more attention to the field. Every country is increasing the support to biomedicine and invests large amount of money to purchase instruments in biomedicine field for scientific researches. So, how to make the most effective use of funding to allocate instruments is abig problem for government. This paper will, from the economic perspective, provide a more reasonable allocation of scientific instruments in biomedicine areato the government.

The importance of scientific instrument for the biomedicine development

Practice is the sole criterion for testing truth. Any research needs a lot of experiments to get a trustable result. The advent of a new type of drug has to pass multiple clinical examinations before being recognized. During the clinical trial process, scientific instruments, used to analysis the effectiveness and stability of drugs, are indispensable. For more than a century, 90.0% of the biomedical award' achievements in the Nobel science prize are completed with a variety of advanced scientific instruments[5]. So find out how to allocate the scientific instruments more reasonable is essential in the development of biomedicine.

ECONOMIC ANALYSIS OF THE SCIENTIFIC INSTRUMENT LAYOUT IN BIOMEDICINE FIELD

Layout analysis of scientific instruments in Chinese biomedicine field

In 2012, in Chinese biomedicine field, the average annual valid working time of scientific instruments was 1143 hours and the utilization rate of these instruments was 81.6%, while the average rating working time is 1400 hours. Although the overall utilization rate was acceptable, there were big variations between different regions. The utilization rate reached 140% in some areas while some were less than 50%. The irrational allocation mainly includes over-disposition and under-disposition.

Over-disposition refers to a region which has more instruments than demand, mainly presented as low utilization rate of equipment. There are three causes of the over-disposition of scientific instruments in Chinese biomedicine field. The first is investing without a good justification. The existing instruments can meet the requirements, but continuouslybuy new instrument without enough investigation. The second is a duplicated application of buying new instruments. Some research institutions often submit one more application for the scientific instrument, which lead to over-disposition in Chinese biomedicine field. The last is the old-fashioned ideas of scientific instrument sharing system in Chinese biomedicine field. Organizations with scientific instruments often take security measures to avoid open to the public, causing the low sharing level of scientific instrument in Chinese biomedicine field.

Under-disposition refers to a region whose instruments can't meet the requirements, mainly presented as exceeded utilization rate. The under-disposition of scientific instrument in Chinese biomedicine field is caused by the backward economic development and under developed scientific research ability at the same time. The less scientific research projects meansthe less admissions of configuring new scientific instruments. This is a vicious circle. So we must consider how to balance the instruments allocation in regions with different economic development status. The objective is to allow each region developing with similar speed.

Justification of the scientific instruments allocation rationality

Since 1980s, performance indicators have been taken to evaluate the large-scale scientific instruments in colleges and universities in the Western developed countries. The performance evaluation has become an important basis for government funding to universities, but the index system is imperfect in efficiency and benefit of equipment utilization[6]. Researches on the effect of science and technology resource allocation in China mainly consider two aspects: allocation efficiency and configuration ability[7]. Integrating the researches of evaluation system of large-scale scientific instruments, the author thinks that in the biomedicine field, the most direct indicator which can measure the rationality of scientific instrument number in a region is the utilization rate of this instrument. Region utilization rate of instrument, reflecting the overall utilization degree in this region, is calculated by weighing utilization rate of unit set according to its original value of area ratio. The statistical formula is:

$$a_i = \sum_x \left(\frac{b_i^x}{u} \times \frac{c_i^x}{\sum_x c_i^x} \right) \times 100\% \qquad x = 1, 2, \ldots, n_i$$

Where, a_i is the utilization rate of instrument in region i; b_i^x is the total effective working time of xth instrument in region i; c_i^x is the original value of xth instrument in region i; n_i is the existing large-scale scientific instrument number in region i and u is the rated working time of scientific instrument in biomedicine field, which is supposed as 1400 hours in this paper.

Utilization rate of instrument can intuitively reflect the instrument configuration level in this area. Assumed that the rational utilization rate of scientific instrument in biomedicine field is within 0.8-1.2. Under-disposition will be considered when the utilization rate is more than 1.2 and over-disposition will be judged when it is less than 0.8. Furthermore, when the rate is over 2.0, an excessive under-disposition condition would happen, which may seriously affect the scientific research and lead to significant loses. At the same time, an excessive over-disposition may lead to a lot of waste of resources when the rate is under 0.5.

Economic analysis of the irrational scientific instruments allocation

Irrational allocation of scientific instruments will bring in economic losses, especially in biomedicine field, with high investment, high risk, better benefits and long cycle characteristics. This session will analysis the losses of irrational instrument allocation qualitatively and propose the calculation method of economic losses quantitatively in biomedicine field.

Economic losses of scientific instrument under-disposition in biomedicine field

If the utilization rate of large-scale scientific instrument is under 1.2, it's reasonable or over-disposition. So the number of new instrument need to be allocated is 0. Under-disposition happens when the utilization rate is over 1.2, in this case, the number of additional instrument can be calculated by utilization rate. The calculation formula is:

$$e_i^1 = \mathrm{int}\left(\frac{a_i u n_i - 1.2u\ n_i}{u} \right) k_i^1 = \mathrm{int}\left(\left(a_i - 1.2 \right) n_i k_i^1 \right)$$

Where, e_i^1 which must be an integer, is the requirement of instrument in region i; k_i^1 is the judging function of utilization rate. $k_i^1 = \begin{cases} 1 & a_i > 1.2 \\ 0 & \text{else} \end{cases}$.

So the economic losses of large-scale scientific instrument under-disposition is:

$$f_i^1 = \beta_i^1 e_i^1$$

Where, f_i^1 is the economic losses of scientific instrument under-disposition in region i; β_i^1 is the economic losses caused by lack of a scientific instrument in region i.

There are two parts of the damages of large-scale scientific instrument under-disposition. One is the direct economic losses. The other is the potential or indirect losses of science development. In this way, a formula can get. $\beta_i^1 = \left(g_i^1 + h_i^1\right)k_i^1$, where, g_i^1 is the direct economic losses and h_i^1 is the indirect losses of science development.

Direct economic losses mainly refers to increased maintenance cost caused by increased wear and tear because of the high instrument utilization rate. Equipment maintenance cost is relevant to instrument utilization rate and original value. So the formula is: $g_i^1 = \varepsilon_1 \left(a_i - 1\right) c_i$. Where, ε_1 is a proportional constant, which get 0.2 more reasonable by consulting experts except some individual areas. And c_i is the instrument average original value in region i.

Indirect losses of science development mainly refers to the great losses caused by having something big in a field but can't obtain the corresponding equipment support. The influence is significant and the losses are unable to be estimated, which may be many times more than purchasing an equipment. So suppose that $h_i^1 = \varepsilon_2 c_i$, where, ε_2 is a constant generally more than 1. Normally $\varepsilon_2 = \begin{cases} 0 & 0.8 < a_i \le 1.2 \\ 1.5 & 1.2 \le a_i \le 2.0 \\ 3 & 2.0 \le a_i < 3.4 \\ 5 & 3.4 \le a_i < 6.26 \end{cases}$ except some individual areas.

Unlike other fields, a little bit medicine finding may bring enormous contribution to human life and health in biomedicine field. The economic value is inestimable, so this situation should be avoided when configuring scientific instrument in biomedicine field.

Economic losses of scientific instrument over-disposition in biomedicine field

Utilization rate less than 0.8 means instrument over-disposition in biomedicine field. In this situation, the instrument is idle most of the time and the amount of surplus equipment is calculated by utilization rate.

$$e_i^2 = \text{int}\left(\frac{0.8u\ n_i - a_i u n_i}{u} \times k_i^2\right) = \text{int}\left(\left(0.8 - a_i\right) n_i k_i^2\right)$$

Where, e_i^2 which must be an integer, is the surplus of instrument in region i; k_i^2 is the judging function. $k_i^2 = \begin{cases} 1 & a_i < 0.8 \\ 0 & \text{else} \end{cases}$

The economic losses of large-scale scientific instrument over-disposition is:

$$f_i^2 = \beta_i^2 e_i^2$$

Where, f_i^2 is the economic losses of scientific instrument over-disposition in region i; β_i^2 is the economic losses caused by surplus one scientific instrument in region i.

Over-disposition of scientific instrument in biomedicine field mainly causes economic losses. First is the waste of purchasing equipment. Because of the redundant equipment can bring certain values and may be needed in the future, a loss coefficient is given here. Second is labor management fees used to manage and maintain the configured instruments. This part of losses can be calculated by multiply the annual salaries of management personnel in this area by the number of management personnel in biomedicine field. Meanwhile, site use fees is merged into labor management fees in this paper. So, the calculation formula of economic losses caused by surplus one large-scale scientific instrument is:

$\beta_i^2 = (\varepsilon_3 \gamma c_i + m q_i) k_i^2$.

Where, $\varepsilon_3 = \begin{cases} 0 & 0.8 < a_i \le 6.26 \\ 0.2 & 0.5 \le a_i \le 0.8 \\ 0.5 & 0.2 \le a_i < 0.5 \\ 1 & a_i < 0.2 \end{cases}$, in which the maximum utilization rate is 6.26 because of there are 8760 hours in a year, and the rated working time is 1400 hours; γ is the depreciation rate of large-scale scientific instrument, which is 0.1 according to Chinese tax law regulating that the depreciation period of general equipment is 10 years; m, generally get 2, is the number of management personnel for one large-scale scientific instrument in region i; q_i is the annual salaries of management personnel is region i.

Based on the above, the economic losses of irrational scientific instrument allocation in biomedicine field is:

$$f_i = f_i^1 + f_i^2.$$

OPTIMIZATION OF THE SCIENTIFIC INSTRUMENT CONFIGURATION IN BIOMEDICINE FIELD

Government must alleviate the scarcity of instrument configuration among various regions mostly when configuring new scientific instruments. So economic losses and sharing distance both need to be considered. This paper construct an economic benefit model based on social force model and calculate the benefit using enumeration method.

Assumptions of instrument configuration

(1) To optimize the scientific instrument configuration in biomedicine field using social force model, following assumptions are given.

(2) When the instrument utilization rate is under 0.8, the existing instruments are not fully used in this region. So there is no need to configure new equipment in order to avoid more waste.

(3) When the instrument utilization rate is over 1.2, the equipment will no longer be shared.

(4) If the instrument utilization rate is under 1.2 after configuration, the redundant working hours will be equally allocated to the surrounding areas.

(5) Determine the sharing costs of instruments using national unified price.

Social force model of the instrument economic benefits

The earliest social force model is put forward by Lewin with the view that the pedestrians' behavior change is caused by a change in social force. Based on Newton dynamics, social force model use expressions of each force to reflect different motivations and effects of pedestrians[8]. Social force model, widely used in traffic evacuation simulation field, is quite reasonable on individual behavior modeling because of the overall consideration on effected individual. The model can give a comprehensive description of the effects of individual change to the whole network, so it applies to the optimization of the large-scale scientific instrument configuration in biomedicine field. This paper, taking the reduced economic losses or economic benefits after instrument configuration as a standard, discusses the relief degree of instrument scarcity brought by new large-scale scientific instrument. The social force model is:

$$F = f_j^0 + \sum_{i \neq j} f_{ji} + \sum_{w} f_{jw}$$

Where, f_j^0 is driving force; f_{ji} is interaction force and f_{jw} is resistance.

Suppose the new instrument is configured in region j, according to the social force model, the formulas are:

$$F_j = f_j^0 + \sum_{i \neq j} f_{ij} - f_{0j}, F_{ji} = f_{ji}^0 - f_{ij} - f_{ji0}$$

Where, F_j is the economic benefits of region j after configuring new scientific instrument in region j and F_{ji} is economic benefits of region i after configuring new scientific instrument in region j.

f_j^0 is the economic benefits of region j brought by alleviating the instrument scarcity after configuring new scientific instrument in region j; f_{ji}^0 is the economic benefits of region i brought by alleviating the instrument scarcity after sharing instrument from region j. The formulas are: $f_j^0 = \frac{u-b_0}{u} \times \beta_j^1$ and $f_{ji}^0 = \frac{b_0}{xu} \times \beta_i^1 \times k$. Where, b_0 is the effective working hours that can be shared after configuration. $b_0 = \begin{cases} u = 1400 & 0.8 \le a_j \le 1.2, a_j^{'} < 1.2 \\ 1.2u(n+1) - a_j^{'} u(n+1) & a_j > 1.2, a_j^{'} < 1.2 \\ 0 & else \end{cases}$, in this formula, $a_j^{'}$ is the instrument utilization rate in region j when configuring one scientific instrument. $a_j^{'} = \frac{a_j un}{(n+1)u} = \frac{a_j n}{(n+1)}$. x is the number of regions whose instrument utilization rate is over 1.2 except region j and $k = \begin{cases} 1 & a_i > 1.2 \\ 0 & else \end{cases}$.

f_{ij} is the economic benefits in region j because of the sharing of region i.

f_{0j} is the economic losses in region j after configuration. It mainly contains equipment management and repair costs, so $f_{0j} = mq_i k$. f_{ji0} is the travel expenses of region i when sharing instrument from region j. $f_{ji0} = zk\left(\eta D + L_{ij}\right) = zk\left(\eta \operatorname{int}(\frac{b_0}{8x}) + L_{ij}\right)$, in which, z is the number of travel people, D is travel days, η is travel allowance per day and L_{ij} is the traffic expense between region i and region j.

Last, if configure new instrument in region j, the economic benefits is:

$$F^J = F_j + \sum_{i \ne j} F_{ji} .$$

Optimizing the configuration schemes using enumeration method

Based on the economic benefit model above, the objective function is: $\max F^J = F_j + \sum_{i \ne j} F_{ji}$. Using enumeration method, place the instrument in each area one by one and choose the maximum economic benefits to configure.

SAMPLE ANALYSIS

Brief introduction of the biomedicine field instrument configuration in the Middle East

According to the survey on Chinese large-scale scientific instrument carried by national science and technology infrastructure center, this paper choose 12 adjacent provincial regions in the Middle East for researching. In research areas, the set number of instruments, whose original value is over ￥500,000, is 5869 with ￥17,430,000 total original value and 0.99 utilization rate. The condition of 12 provincial regions' instrument configuration is as TABLE 1.

TABLE 1 : The condition of selected regions' instrument configuration

Region	Instrument original value(￥)	Average original value(￥)	Set number of instrument	Utilization rate	Demand (Surplus) number(set)
1	318478501.7	1037389	307	0.72	0（26）
2	508102126.1	1302826	390	1.18	0（0）
3	1787344195	1448415	1234	1.02	0（0）
4	107085077.2	1115470	96	0.84	0（0）
5	427182548	1520223	281	1.18	0（0）
6	11064422.77	851109.4	13	0.28	0（7）
7	73642878.23	1067288	69	1.25	3（0）
8	995255029.6	1261413	789	1.17	0（0）
9	223638917	1256398	178	1.27	12（0）
10	206479336.5	1229044	168	0.70	0(17)
11	151805034.2	1150038	132	0.58	0(28)
12	3296747594	1490392	2212	0.91	0（0）

Economic analysis of the biomedicine field instrument configuration in the middle east

The selected regions as a whole have a reasonable disposition and have no economic losses according to the economic analysis model since the instrument utilization rate is 0.99. But among the 12 regions, only 6 have the reasonable disposition. Instrument utilization rates in 2 regions are over 1.2, in 4 regions are under 0.8 and in No.6 region is only 0.28. So the selected regions' instrument configuration is not reasonable. The under-disposition regions are No.7 and No.9 and the over-disposition regions are No.1, No.6, No.10 and No.11.

The economic losses brought by under-disposition in the selected regions are:

$$f^1 = f_7^1 + f_9^1.$$

$$f_7^1 = \beta_7^1 e_7^1 = \left(\varepsilon_1\left(a_7 - 1\right)c_7 + \varepsilon_2 c_7\right)k_7^1 e_7^1 = \left(0.2\left(1.25-1\right)\times 1067288 + 1.5\times 1067288\right)\times 1\times 3$$

$$= ¥4,962,889$$

$$f_9^1 = \beta_9^1 e_9^1 = \left(\varepsilon_1\left(a_9 - 1\right)c_9 + \varepsilon_2 c_9\right)k_9^1 e_9^1$$

$$= \left(0.2\left(1.27-1\right)\times 1256398 + 1.5\times 1256398\right)\times 1\times 12$$

$$= ¥23,429,310$$

$$f^1 = f_7^1 + f_9^1 = ¥28,392,199$$

The economic losses brought by over-disposition in the selected regions are: $f^2 = f_1^2 + f_6^2 + f_{10}^2 + f_{11}^2$. The investigation shows that the minimum wage of the 4 regions are ￥18,000, ￥144,000, ￥144,000 and ￥15,840.

$$f_1^2 = \beta_1^2 e_1^2 = \left(\varepsilon_3 \gamma c_1 + m q_1\right)k_1^2 e_1^2$$

$$= \left(0.2\times 0.1\times 1037389 + 2\times 18000\right)\times 1\times 26$$

$$= ¥1,475,442$$

$$f_6^2 = \beta_6^2 e_6^2 = \left(\varepsilon_3 \gamma c_6 + m q_6\right)k_6^2 e_6^2$$

$$= \left(0.5\times 0.1\times 851109.4 + 2\times 14400\right)\times 1\times 7$$

$$= ¥499,488$$

$$f_{10}^2 = \beta_{10}^2 e_{10}^2 = \left(\varepsilon_3 \gamma c_{10} + m q_{10}\right)k_{10}^2 e_{10}^2$$

$$= \left(0.2\times 0.1\times 1229044 + 2\times 14400\right)\times 1\times 17$$

$$= ¥907,475$$

$$f_{11}^2 = \beta_{11}^2 e_{11}^2 = \left(\varepsilon_3 \gamma c_{11} + m q_{11}\right)k_{11}^2 e_{11}^2$$

$$= \left(0.2\times 0.1\times 1150038 + 2\times 15840\right)\times 1\times 28$$

$$= ¥1,531,061$$

$$f^2 = f_1^2 + f_6^2 + f_{10}^2 + f_{11}^2 = ¥4,413,466$$

The economic losses because of the unreasonable instrument configuration in the selected regions are:

$$f = f^1 + f^2 = ¥32,805,665$$

Optimization scheme of the biomedicine field instrument configuration in the Middle East

The country decides to configure one instrument in 8 of the 12 selected regions according to the existing configuration condition. Traffic expense between the 8 regions and daily travel allowance to each region are shown in TABLE 2.

TABLE 2 : Traffic expense, allowance and the minimum annual salary in the 8 regions

Region / Region	2	3	4	5	7	8	9	12	Daily travel allowance (¥)	Minimum annual salary (¥)
2	0	1033	328	532	613	809	755	109	300	20160
3	1033	0	643	1036	380	279	410	1106	400	19440
4	328	643	0	430	678	559	527	388	200	15480
5	532	1036	430	0	643	797	765	628	300	18000
7	613	380	678	643	0	296	252	613	200	14760
8	809	279	559	797	296	0	121	887	300	15840
9	755	410	527	765	252	121	0	855	200	15120
12	109	1106	388	628	613	887	855	0	400	18720

If the instrument is configured at No.2 region, the instrument utilization rate is:

$$a_2^{'} = \frac{a_2 n}{(n+1)} = \frac{1.18 \times 390}{(390+1)} = 1.177, \quad b_0 = 1400, \quad f_j^0 = 0,$$

$$f_{02} = mq_2 = 2 \times 20160 = ¥40,320$$

$$F_2 = f_2^0 + \sum_{i \neq j} F_{ji} - f_{02} = \sum_{i \neq j} F_{ji} - 40320$$

$$F_{23} = F_{24} = F_{25} = F_{28} = F_{2,12} = 0$$

$$\begin{aligned} F_{27} &= f_{27}^0 - f_{72} - f_{270} = \frac{b_0}{2 \times u} \beta_7^1 - f_{72} - zk\left(\eta D + L_{ij}\right) \\ &= \frac{1400}{2 \times 1400} \times 1654296.40 - f_{72} - 3 \times 1\left(300 \times \mathrm{int}(\frac{1400}{2 \times 8}) + 613\right) \\ &= 746109.2 - f_{72} \end{aligned}$$

$$\begin{aligned} F_{29} &= f_{29}^0 - f_{92} - f_{290} = \frac{b_0}{2 \times u} \beta_9^1 - f_{92} - zk\left(\eta D + L_{ij}\right) \\ &= \frac{1400}{2 \times 1400} \times 1952442.49 - f_{92} - 3 \times 1\left(200 \times \mathrm{int}(\frac{1400}{2 \times 8}) + 755\right) \\ &= 921156.2 - f_{92} \end{aligned}$$

$$F^{J} = F_j + \sum_{i \neq j} F_{ji} = F_2 + F_{23} + F_{24} + F_{25} + F_{28} + F_{2,12} + F_{27} + F_{29}$$
$$= ¥1,626,945.4$$

Similarly, configure the instrument at other regions and calculate each economic benefits.

$F^{3} = ¥1,550,919$; $F^{4} = ¥1,663,194$; $F^{5} = ¥1,604,745$; $F^{8} = ¥1,612,038$;
$F^{12} = ¥1,550,325$; $F^{7} = ¥1,654,296$; $F^{9} = ¥1,952,442$

The results shows that configuring the instrument at No.9 region has the maximum benefits which is ￥1,952,442.

CONCLUSION

This paper firstly evaluates the allocation of scientific instrument using economic analysis model and reach the conclusion that the configuration of instruments in Chinese biomedicine field is unbalanced, which means some instruments are idle but some are overburdened. Then, through sorting out the unreasonable allocation, further study on the instrument configuration is put forward and proposes an optimization model using social force model with the research objective of economic losses alleviated after configuring an instrument. The optimization model solves the scarcity of instrument and considers the shortest sharing distance at the same time. It is not only suitable for the nationwide instrument configuration, but also for the instrument configuration of a region even a unit. Meanwhile, the model, which can provide a theoretical basis for instrument configuration, considers every factor comprehensively and can truly reflect the economy of instrument configuration. But there are also shortcomings at the same time, for example, a uniform pricing is absent for instrument sharing in China and the price of different regions sharing instrument with the same region may not the same. This paper only considers the utilization and sharing for adding new equipment, but not considers for the existing instrument that are insufficient utilized. The problems will be solved in the future researches.

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