Evaluating the Effect of Physician Personal Brand on Medical Resource Allocation in Taiwan

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Background/objective:

Patients in Taiwan deeply believe that only a physician with high personal brand can offer better medical care service. This would result in distortion of the accessibility of healthcare resources, especially in the rural areas. However, few of past studies successfully deal with the problem of the medical resource misallocation.

Research process：

The paper is organized as follows. First we reviewed literature of relevant topic. Further in the research method section that presented evaluation methods. Than base on patients opinion in Taipei city hospital. Finally, according to the findings of this research, conclusions, and suggestions are presented in discussion.

Method:

The DEMATEL method is an effective procedure of analyzing structure and relationships between components of a system or a number of available alternatives.

In this research we employed fuzzy DEMATEL method to delete the fuzzy factors existed in human decision making process and handle the inner dependences within a set of criteria.

The proposed framework：

Step 1: Establish a committee composed by *p* patients opinion in Taipei city hospital.

Step 2: Follow patient's opinion result to set up user satisfaction factor and to design fuzzy linguistic scale.

In this research, triangular fuzzy number is adopted, hence, the following definition is made first.

Definition: A fuzzy number A is a triangular fuzzy number if its membership function has $0 < l \leq m \leq u \leq \infty$, (Ding &Liang, 2005)

$$l \leq x \leq m$$
$$m \leq x \leq u$$

otherwise

$$\mu_A = \begin{cases} (x-l)/(m-l) \\ (u-x)/(u-m) \\ 0 \end{cases},$$

In the patient's assessment on the influential scale among factors, we have adopted five classes of No, VL, L, H and VH, which have representative meaning and corresponding linguistic values as in table 1.

Table1 The correspondence of linguistic terms and linguistic values

Linguistic terms	Linguistic values
Very high influence (VH)	(0.75,1.0,1.0)
High influence (H)	(0.5,0.75,1.0)
Low influence (L)	(0.25,0.5,0.75)
Very low influence (VL)	(0,0.25,0.5)
No influence (No)	(0,0,0.25)

Step3: Acquire the assessments of patients.

Based on patient suggestion which invited 25, 12 revisit patients and 13 fist visit patients. the pair-wise comparisons of each factor are provided by the patients.

Step 4: Generate the initial direct-relation matrices.

Denote $\mathrm{Z}_2^{(\mathrm{n})} = \left[\mathrm{z}_{2\mathrm{ij}}^{(\mathrm{n})}\right] = \left[\left(\mathrm{l}_{2\mathrm{ij}}^{\mathrm{n}}, \mathrm{m}_{2\mathrm{ij}}^{\mathrm{n}}, \mathrm{u}_{2\mathrm{ij}}^{\mathrm{n}}\right)\right]$ to be the degree of direct influence of the i^{th} factor to the j^{th} factor evaluated by the n^{th} expert , $\mathrm{n} = 1,2,\ldots,\mathrm{p_i}$, $\mathrm{i,j} = 1,2,\ldots,p$

$\widetilde{\mathrm{X}}_2 = \left[\tilde{\mathrm{x}}_{2\mathrm{ij}}\right] = \left[\left(\tilde{\mathrm{l}}_{2\mathrm{ij}}, \tilde{\mathrm{m}}_{2\mathrm{ij}}, \tilde{\mathrm{u}}_{2\mathrm{ij}}\right)\right]$ means initial direct-relation matrix based on patient's opinion.

Step 5: Decomposition

According to the linearity of matrix algebra, we decompose

$\widetilde{\mathrm{X}}_2 = \left[\tilde{\mathrm{x}}_{2\mathrm{ij}}\right] = \left[\left(\tilde{\mathrm{l}}_{2\mathrm{ij}}, \tilde{\mathrm{m}}_{2\mathrm{ij}}, \tilde{\mathrm{u}}_{2\mathrm{ij}}\right)\right]$ into the following three matrices.

$\tilde{L}_2 = \left[\tilde{l}_{2ij}\right],\ \tilde{M}_2 = \left[\tilde{m}_{2ij}\right],\ \tilde{U}_2 = \left[\tilde{u}_{2ij}\right]$

Step 6: Normalization

Calculate γ_1 and γ_2 through the following formulas.

$$\gamma_1 = Min\left(\frac{1}{Max\left(\sum_{i=1}^{h}\tilde{x}_{1ij}\right)}, \frac{1}{Max\left(\sum_{j=1}^{h}\tilde{x}_{1ij}\right)}\right),$$

$$\gamma_2 = Min\left(\frac{1}{Max\left(\sum_{i=1}^{h}\tilde{u}_{2ij}\right)}, \frac{1}{Max\left(\sum_{j=1}^{h}\tilde{u}_{2ij}\right)}\right)$$

Then, we have the normalized matrices by multiplying γ_k and the initial-relation matrices.

$\tilde{X}_k^{norm} = \gamma_k \tilde{X}_k = \left[\tilde{x}_{kij}^{norm}\right]$

For *k=2*, the following matrices can also be computed.

$\tilde{L}_2^{norm} = \gamma_2 \tilde{L}_2 = \left[\tilde{l}_{2ij}^{norm}\right],$

$\tilde{M}_2^{norm} = \gamma_2 \tilde{M}_2 = \left[\tilde{m}_{2ij}^{norm}\right],$

$\tilde{U}_2^{norm} = \gamma_2 \tilde{U}_2 = \left[\tilde{u}_{2ij}^{norm}\right]$

Step 7: Compute the total-relation matrices.

$X_k^T = \tilde{X}_k^{norm}\left(I - \tilde{X}_k^{norm}\right)^{-1} = \left[x_{kij}\right],$

For *k=2*, the decomposed total-relation matrices are

$\tilde{L}_2^T = \tilde{L}_2^{norm}\left(I - \tilde{L}_2^{norm}\right)^{-1} = \left[\tilde{l}_{2ij}^T\right]$,
$\tilde{M}_2^T = \tilde{M}_2^{norm}\left(I - \tilde{M}_2^{norm}\right)^{-1} = \left[\tilde{m}_{2ij}^T\right]$,
$\tilde{U}_2^T = \tilde{U}_2^{norm}\left(I - \tilde{U}_2^{norm}\right)^{-1} = \left[\tilde{u}_{2ij}^T\right]$,
Where I is a $h\times h$ identity matrix.
For $k=1$, go to Step 10

Step 8: Defuzzification

We use the principle of finding the center of gravity of a triangular shape to find out the center value of fuzzy set to represent the entire fuzzy set. The defuzzification operation method is as shown in the followings:

Defuzzification point:

$X_{2ij} = \frac{1}{3}\left[\left(\tilde{l}_{2ij}^T - \tilde{u}_{2ij}^T\right) + \left(\tilde{m}_{2ij}^T - \tilde{u}_{2ij}^T\right)\right] + \tilde{u}_{2ij}^T$

Step 9: Plot and combine the causal diagrams.

Step 10.1: Compute $D_{ki,}R_{kj,}D_{ki} + R_{kj}, D_{ki} - R_{kj}$

$$D_{ki} = \sum_{j=1}^{h} x_{kij} \quad , \quad R_{kj} = \sum_{i=1}^{h} x_{kij}$$

Step 10.2: Plot and combine the causal diagrams

We are following the process of above step by step as below:

Table 2: the original data (revisit and first visit patients include)

	revisit patients				**First visit patients**			
	values	**leadership**	**personality**	**competence**	**values**	**leadership**	**personality**	**competence**
values	—	**VL**	**VVH**	**H**	—	**H**	**VH**	**VVH**
leadership	**VVH**	—	**VH**	**L**	**H**	—	**VH**	**VVH**
personality	**VVH**	**VL**	—	**H**	**H**	**H**	—	**VVH**
competence	**VL**	**H**	**VH**	—	**VL**	**VVH**	**VH**	—

Table 3: linguistic values

	revisit patients				**First visit patients**			
	values	**leadership**	**personality**	**competence**	**values**	**leadership**	**personality**	**competence**
values	**0**	**0.25**	**0**	**0.75**	**0**	**0.75**	**1**	**0**
leadership	**0**	**0**	**1**	**0**	**0.75**	**0**	**1**	**0**
personality	**0**	**0.25**	**0**	**0**	**0.75**	**0.75**	**0**	**0**
competence	**0.25**	**0.75**	**0**	**0**	**0.25**	**0**	**1**	**0**

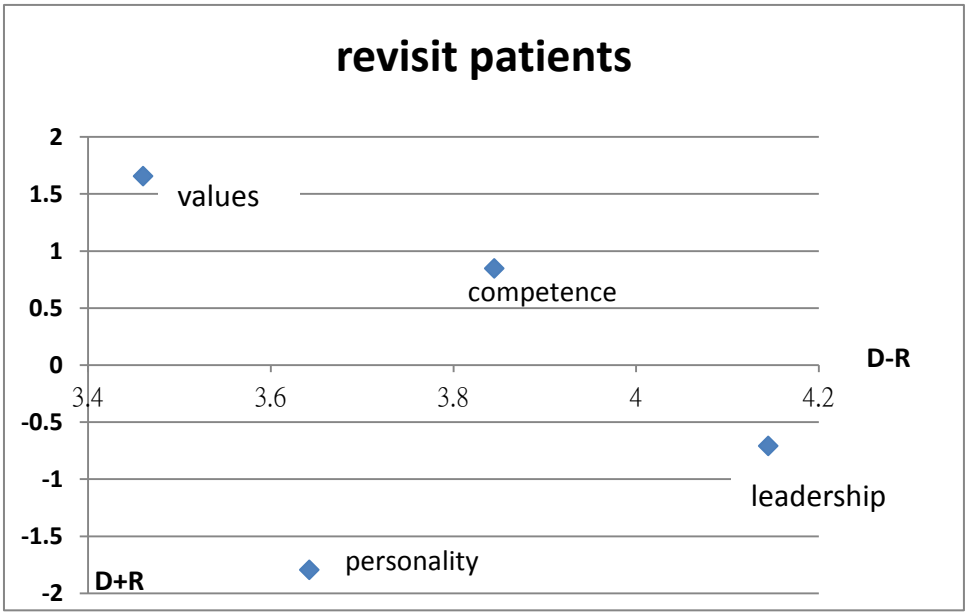
Table 4: Result of Generate and Defuzzification

	revisit patients				First visit patients			
	values	leadership	personality	competence	values	leadership	personality	competence
values	0.67142857	1.208571	0.951429	1.105714	0.803353659	0.971037	1.030488	0.317073
leadership	0.51428571	0.825714	1.054286	0.617143	0.990853659	0.783537	1.030488	0.317073
personality	0.42857142	0.771429	0.628571	0.514286	0.990853659	0.971037	0.842988	0.317073
competence	0.72857142	1.311429	0.968571	0.774286	0.713414634	0.634146	0.871951	0.268293

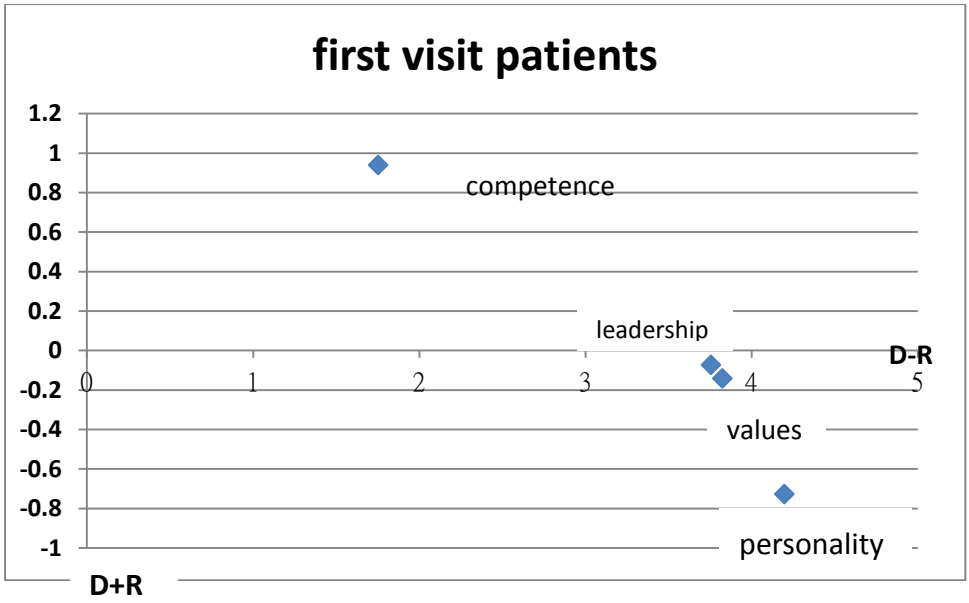
Table 5: R+D, R-D

	revisit patients		First visit patients	
	D+R	D-R	D+R	D-R
values	3.460337	1.656008	3.824363	-0.14082
leadership	4.144829	-0.70864	3.755901	-0.07236
personality	3.642318	-1.7947	4.197515	-0.72686
Competence	3.844848	0.84733	1.753046	0.940038

Plot 1: cause and effect diagram for revisit patients



Plot 2: cause and effect diagram for first visit patients



Results: Through evaluating and analyzing the impact of the four aspects of physician personal brand which are competence, value, personality and leadership on patient's willing to be treated by a specific physician, we are finding：

1. Competence is the most important factor of physician personal brand.
2. Competence is the most important factor that will influence patients to choose doctor both revisit and first visit.
3. Doctor's values will influence revisit patients and doctor's personality and leadership.
4. Very interesting is that first visit patient chose doctor unaffected of doctor's values personality and leadership but competence. Yet, doctor's leadership personality and values are affected by competence.

Implication

Due to competence is the most important factor of physician personal brand. It will influence patient to choose doctor both first visit and revisit. Therefore, government should provide more training of physician to short distance of city and rural. The other way is to provide offers and incentives to physicians with exceptional competence in order to encourage them to stay in the rural areas.