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Using Conjoint Analysis to Investigate Hospital Directors' Preference in Adoption of an Evidence-based Intervention

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Abstract

This study used conjoint analysis, a marketing research technique, to investigate hospital stakeholders' decision-making in adoption of evidence-based interventions (EBI). An efficacious hospital-based stigma-reduction intervention was used as a "product" to study adoption of EBI. Sixty hospital directors in Fujian, China evaluated the likelihood of adopting the EBI in their hospitals by rating across eight hypothetical scenarios with preferred and non-preferred levels of seven attributes, including 1) administrative support, 2) cost, 3) personnel involvement, 4) format, 5) duration, 6) technical support, and 7) priority alignment with the hospital. A hierarchical generalized linear model was fit to the likelihood of intervention adoption for the eight scenarios, with the seven attributes served as independent variables. Monetary cost of intervention implementation (impact score=2.12) had the greatest impact on the directors' reported likelihood of adopting the EBI, followed by duration of the intervention (impact score=0.88), availability of technical support (impact score=0.69), and flexibility of format (impact score=0.36). The impact scores of other attributes were not statistically significant. Conjoint analysis was feasible in modeling hospital directors' decision-making in adoption of EBI. The findings suggested the importance of considering cost, duration, technical support, and flexibility of format in development and dissemination of interventions in healthcare settings.

Keywords

Conjoint analysis; Evidence-based intervention; Intervention adoption; Dissemination and implementation research; Hospital stakeholders

Introduction

Over the last few decades, a large number of behavioral interventions have demonstrated efficacy in randomized controlled trial conditions. However, only a limited number of these

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Disclosure of interest

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evidence-based interventions (EBI) have been successfully adopted and implemented in real-world healthcare settings [1]. The EBI, if not properly and adequately utilized in practice, will generate limited impact on public health [2]. There is an urgent need to use innovative approaches to facilitate the translation of research into practice [3, 4]. Literature has identified multiple factors that would influence the adoption of a certain EBI, including the credibility of resource, magnitude of evidence, intensity and length of training, availability of support, staffing requirements, resource requirements, and organizational priorities and implementation climates. [5]. Policymaker and stakeholders' decision-making in adoption of a certain EBI would inevitably involve tradeoffs across these factors. In addition, agency stakeholders' intention to adopt a certain EBI could also be influenced by their educational background and perceived behavioral control [6]. Understanding the healthcare stakeholders' preferences in different aspects of EBI is the vital first step in facilitating the adoption of EBI in healthcare practice [7].

Conjoint analysis is a popular marketing research technique that marketers use to determine how consumers make decisions and what they value in products when making a purchase [8]. The statistical technique starts with defining a product with a set of features (attributes), and each attribute can then be broken down into a number of levels. First, the customers would be presented with a series of combination of attributes and levels, and then asked to rate their preference of each combination [9, 10]. The statistical analysis of respondents' preference rating would allow researchers to quantify the value (or the impact score) of each product attributes in terms of its contribution to the customer's decision. The method has been applied in health research to study individual acceptability of healthcare services, such as HIV testing, vaccine, and microbicides [11, 12, 13].

The concept of conjoint analysis can be used in the implementation and dissemination research to quantify the values the hospital stakeholders place on different features of EBI, and to investigate the hidden rules stakeholders use to make trade-off decisions. In this study, we used a real-life intervention model with efficacious outcomes as a "product" to study the adoption of EBI. Conjoint analysis was employed to calculate the relative importance of different attributes of the intervention model, modeling the stakeholders' preferences and decision-making. Instead of assessing preference one attribute at a time, multiple intervention attributes were presented as a composite bundle, thereby gaining insight into which specific intervention attributes mostly influence hospital directors' decision to adopt the intervention in their healthcare settings. In addition, we expected variations related to intervention adoption across different types of hospital settings and leadership backgrounds; therefore, we explored the relationship between the hospital stakeholders' decision making with the hospital as well as their individual characteristics.

Methods

The EBI

During 2008 to 2010, the randomized controlled intervention trial named "White Coat, Warm Heart" (WW Intervention) was conducted in 40 county-level hospitals in Fujian and Yunnan Provinces of China, with the aim to reduce service providers' stigmatizing attitudes and behaviors towards people living with HIV (PLH). Guided by the Diffusion of Innovation

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theory, about 15% of the popular opinion leaders were identified and trained among the service providers to disseminate stigma reduction messages within their medical community. At the same time, universal precaution supplies (such as gloves, masks and sharps containers) were provided to address structural level barriers to self-protection. The intervention demonstrated promising outcomes as the intervention hospital providers showed significantly reduced prejudicial attitude towards PLH and less avoidance to provide service to PLH [14]. The WW Intervention was used as an example study the hospital directors' decision-making.

Assigning Attributes of the EBI

Based on literature review and preliminary informative interviews with hospital directors, seven features (attributes) of evidence-based interventions were identified to be influential in the decision to adopt the intervention models: 1) availability of administrative support, 2) cost, 3) personnel involvement, 4) format, 5) duration, 6) availability of technical support, and 7) the priority alignment with the hospital. Local healthcare administration experts confirmed the completeness and appropriateness of the list of the attributes. To avoid complexity and to maximize the response rate, we assigned two levels, a preferred level and a non-preferred level, for each attribute [15]. The seven dichotomous attributes with two levels each would yield 128 possible scenarios ($2^7 = 128$), which would be too burdensome to administer. So we used fractional factorial orthogonal design, a method commonly employed in conjoint research, to reduce the number of scenarios to eight [16]. The eight scenarios as specific combinations of the seven attributes are presented in Table 1. For example, the first scenario has the following attribute profiles: minimum administrative support, minimum monetary cost to the hospital, need to involve many (50%) staff in the hospital, short-term intervention with flexible (internet-based) format and maximum technical support available, and stigma-reduction being not aligned with current hospital priority.

Study Participants

The study was conducted in Fujian Province, one of the provinces that WW Intervention was originally implemented. The study participants included 60 hospital directors recruited from 30 hospitals of different levels (provincial-, city-, and county-level) and types (general hospitals and specialized hospitals), with two directors recruited from each hospital. The sample size was determined based on the rules-of-thumb [14], the availability of budget and potential participants, and previous experience [12]. The participants had to be 1) 18 years and above and 2) a director (or deputy director) of a hospital in the study area to participate. The study recruiter visited the study hospitals and introduced the study to the hospital directors. The directors either participated in the study themselves or appointed deputy directors who were in charge of nosocomial infection prevention, staff training, and provider occupational protection to participate. When approaching potential participants, the study recruiters followed a standardized script to fully disclose all study objectives and procedures, and to ensure that all ethical issues and study procedures were reviewed. It was emphasized that participation in the study was completely voluntary and the research was not part of their job responsibility. Oral informed consent was obtained prior to the data collection. The

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study procedures and materials were reviewed and approved by the Institutional Review Boards of the participating agencies in China and the United States.

Conjoint Scenario Administration

Before the official commencement of data collection, we have conducted a pilot study in two hospitals with four hospital directors to test the conjoint scenario administration procedures (described below). The pilot study participants provided feedback on the overall data collection procedure, as well as their understanding of the designed attributes and the response levels for each attribute.

The conjoined scenarios were administered with hospital directors by trained interviewers on a one-on-one, face-to-face format. The interviewers first introduced the purpose, design, and the promising outcome of the WW intervention (as described in the first paragraph of the Methods section), and then asked the hospital directors to rate the likelihood that this intervention model (without external funding) is adopted in their hospitals under the eight hypothetical scenarios. The eight intervention scenarios were presented one at a time using a set of laminated cards, and the interviewer explained the definitions of each attribute and the level. The order of the scenarios presentation (as listed in Table 1) was always the same for every director. The likelihood for intervention adoption in each scenario was recorded using a 5-point Likert-scale from “1 = highly unlikely”, “2 = somewhat unlikely”, “3 = neutral”, “4 = somewhat likely”, to “5 = highly likely”.

Other Measures

In addition to the conjoint scenario administration described above, the hospital directors also completed a self-administered paper-pencil questionnaire which collected the following hospital characteristics (including the type and the level of the hospital, the number of hospital bed, and number of healthcare providers, and if the hospital had participated in the original WW Intervention) and individual characteristics (including age, gender, education, the duration of service in the current hospital, and current position and professional title). At the end of the questionnaire, the hospital directors were asked to evaluate if the process of conjoint scenario administration was clear and easy to understand (yes or no). The respondents who gave a negative answer were asked to provide a brief open-ended explanation. The whole data collection process took approximately 30 minutes to complete. A compensation of 300 yuan (approximately 45 USD) was offered to the participants for their time and effort.

Data Analysis

The statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC). The hospital and hospital directors’ characteristics were first descriptively analyzed. Second, a hierarchical generalized linear model was fit to the likelihood of intervention adoption for the eight scenarios across all respondents (N = 8 scenarios per respondent x 60 respondents = 480). Using SAS PROC GLIMMIX, the model treated the likelihood of intervention adoption as an ordinal outcome, with ‘highly likely’ scored as 5 and ‘highly unlikely’ scored as 1 [17]. The seven attributes (categorized as preferred = 1 or not preferred = 0) served as independent variables in the model. The model included a respondent-level random effect to

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account for the clustering structure of the responses (i.e., responses to the eight scenarios were clustered within respondents). The regression coefficient for each attribute in the hierarchical generalized linear model was the impact score of the attribute on the likelihood of adoption. Third, for each respondent, a multiple regression model was fit to the likelihood of adoption, the seven attributes again served as independent variables and the regression coefficients for the attributes were the impact scores of the attributes on adoption likelihood for the individual respondent. We explored the relationship between the impact score of each attribute and individual/hospital characteristics using Pearson's correlation coefficient.

Results

Sample Characteristics

The characteristics of participating hospitals and individuals are summarized in Table 2. Most (23, 76.7%) of the 30 participating hospitals are general hospitals. Provincial level, city level, and country level hospital each accounted for one third of the sample. The hospitals had on average 967.6 beds. Approximately half (14; 46.7%) of the hospitals provided antiretroviral therapy (ART) at the time of the study. The hospitals reported on average 24.1 HIV cases in the past year. A total of 9 (30.0%) of the hospitals participated in the original WW Intervention, and 6 (20.0%) were intervention hospitals. The majority of the hospital directors (47; 78.3%) were male with the average age of 49.5 years. Approximately half (32; 53.3%) had served in the current hospital between 21 and 30 years. The vast majority (58; 96.7%) had a Bachelor's or higher degree. At the time of the study, 47 (78.3%) of the respondents held a vice senior or senior professional title.

Impact of the Intervention Attributes on Likelihood of Adoption

The summary statistics of the likelihood of adoption score across all directors for each of the eight hypothetical scenarios is displayed in the last two columns of Table 1. The likelihood of adoption score is presented based on the 5-point Likert scale used for each scenario in the interview, e.g. a higher the score indicates a higher likelihood of a scenario to be adopted. Scenarios number 1 and number 4 were rated as the most accepted scenarios, which both feature low cost, short duration of intervention, and maximum technical support. Table 3 illustrates the impact score of the seven attributes on the likelihood to adopt the EBI. The monetary cost of the intervention implementation had the greatest impact on the likelihood of the EBI adoption (impact score = 2.12; $p<0.0001$). Duration of the intervention had the second highest impact (impact score = 0.88; $p<0.0001$). The availability of technical support (impact score = 0.69; $p<0.0001$) and flexibility of intervention format (impact score = 0.36; $p = 0.0368$) also had an impact on the hospital directors' consideration. The impact scores of administrative support, personnel involvement, and priority alignment did not reach statistical significance on the likelihood of intervention adoption.

Factors Associated with Each Hospital Directors' Attribute Impact Scores

Pearson's correlation between attribute impact scores of each respondent and his/her individual background and hospital characteristics revealed that the directors who have been working in the healthcare setting for a longer period of time were less likely to consider priority alignment of the EBI with the hospital ($r = -0.288$; $p = 0.026$). The directors from

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WW Intervention hospitals were more likely to consider the intervention format (r = 0.277; p = 0.032). No other association between attribute impact scores and hospital/individual characteristics were found to be statistically significant.

Feasibility of Conjoint Scenario Administration

The majority (n = 53; 88.3%) of the hospital directors in the study reported the administration of conjoint scenarios was clear and easy to understand. The seven directors who disagreed perceived the presentation of eight hypothetical scenarios being somewhat "confusing" (n = 3), "not realistic" (n = 2), or the attribute assignment being "not specific" (n = 2). The interviewers reported that the assessment process was straightforward, and the conjoint scenario administration component took approximately ten minutes to complete. The most challenging part of the study lied in coordinating with the hospital directors and arranging a time within their tight working schedule to conduct the assessment.

Discussion

Although numerous EBI and healthcare practices are available for a wide range of health issues, the dissemination, selection, and adoption of these EBI in real-life settings involve a complex interplay among political and social contexts, healthcare organizations, key stakeholders, individual providers, and the packaging of the EBI itself [5, 18, 19]. The application of conjoint analysis in the study, which combined a real-life example of EBI with multifaceted and multilevel attributes, provided insights of the value that decision makers place on features of a given intervention package. The method has increasingly been applied in implementation research, because as compared to conventional prioritization methods, conjoint analysis has several advantages: first, the method offers greater realism, grounds attributes in concrete descriptions, and extends the idea of side-by-side comparisons [15]; second, instead of "stated importance", the method provides more scientific rigor by quantifying "derived importance" values for each attribute or feature in the process of decision-making [20,21,22,23]; and third, conjoint analysis offers the potential of using a simulation model to predict of how hospital stakeholders would respond to a new EBI or changes to existing intervention models [24]. The relatively short data collection time, the respondents' positive evaluation, and meaningful results, all suggested the feasibility of this method is in assessing intervention adoption preferences among hospital stakeholders.

There were several issues that one should consider when operationalizing conjoint analysis in dissemination and implementation research: 1) using real-life EBI example vs. hypothetical innovations. We chose to use a particular real-life intervention trial as an example to provide the respondents with a concrete idea of EBI. Several hospitals actually participated in the WW Intervention so that their directors had an objective perception of the EBI. The stakeholder preferences identified in the study are not limited to the stigma reduction intervention only. To the contrary, it provides implications for EBI adoption for other projects and in other contexts; 2) assigning the component level of the attributes: it was suggested that the levels of attributes should be stated in concrete terms [22]. Therefore, we have provided specific examples of component levels for some of the attributes, including personnel involvement, duration of the intervention, and format. For the "cost" attribute, we

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originally specified “200 Chinese yuan per person” and “500 Chinese yuan per person” as examples of being “relatively cheap” and “relatively expensive”. However, in the pilot stage, we found that the respondents’ interpretation of the amount differed substantially due to different economic conditions across hospitals, thus we did not enumerate the values for the “cost” attribute; 3) generating scenarios: in this study, the eight scenarios were purely generated using mathematical method, e.g. fractional factorial orthogonal design. As two of the respondents pointed out, some of the scenarios may be unrealistic. Future studies would consider the practical meaning and real-life relevancy of the hypothetical combinations generated by mathematical methods; and 4) interviewer training: the conjoint scenario administration, especially with hospital directors, would require a higher level of interview skills than a usual questionnaire survey. All interviewers in this study underwent extensive training in rapport establishment, interviewing techniques, concepts and steps of conjoint analysis, and conjoint scenario administration. Additionally, the training placed great emphasis on the description of the WW intervention, to ensure the standardization and unbiased nature of the EBI introduction.

The finding of the study suggests that intervention efforts, throughout developmental to dissemination stage, should consider and address the contextual needs of its target users. The study suggested that adoption of EBI is mostly influenced by the intervention cost, duration, availability of technical support, and flexibility of format. These findings are consistent with previous research demonstrating that hospital directors are facing limited resources and substantial fiscal responsibility, so they strive for clinical improvement strategies that are simple to implement and cost-effective [25, 26]. As busy working schedule has always been a barrier to conduct training for healthcare professionals [27], flexibility and control of time need to be addressed carefully for intervention efforts involving healthcare providers. Implementation science theoretical frameworks specify that the organizational and contextual features (e.g., political circumstances, local expertise, reward systems, etc.) influence the success of hospital-based quality improvement projects [28, 29]. The findings confirmed the importance of shaping interventions in light of available institutional support. Specifically, providing sufficient technical support is more vital than having administrative support in intervention adoption. Therefore, intervention designers need to consider the plan for effective technology exchange at the intervention developmental stage. The strategies could be contracting external consultant, identifying and training local expertise, or the combination of both [30].

Conjoint analysis could go beyond attribute ranking and provider understanding in differentiated decision-making as a result of contextual factors and individual profiles. However, in this study, we included 60 hospital directors, and the sample size was not powerful enough to identify meaningful relationships between individual/hospital background characteristics and impact scores of attributes. Given the semi-qualitative nature of conjoint analysis, there is no hypothesis that allows a formal sample size calculation [31]. Previous studies using conjoint analysis indicated that a sample size of 50 participants would have enough power [19, 32]. The sample size would be enough to examine the main effects of seven attributes with two levels each. However, studies with the purpose to compare subgroups of respondents and identify group differences would require a larger sample size to accommodate a minimum number of respondents in each subgroup [15]. Future research

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should consider increasing sample size so that the factors potentially impacting the respondents' preferences could be identified.

As with other studies, our study had some limitations. First, the study was conducted in one province of China, and the settings and participants were selected through a non-random sampling procedure, so that the findings may not be generalizable to other areas or other healthcare settings. Second, the conjoint analysis of the study might have omitted other important intervention attributes that have potential influences on the likelihood of adopting a certain EBI. Third, we would not be able to predict the actual adoption of EBI in healthcare settings based on the hospital directors' self-reported likelihood of adoption.

In conclusion, conjoint analysis is a feasible and useful tool in dissemination and implementation research to quantify healthcare decision makers' preferences for the adoption of evidence-based behavioral interventions. The findings underscored the importance of considering the cost, duration, availability of technical support, and flexibility of format in development and dissemination of behavioral interventions in healthcare settings.

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Table 1.

The Attributes and Scenarios of the Evidence-based Intervention (EBI) (“White Coat, Warm Heart” Intervention)

The order of Scenario presentation	Attributes							Likelihood of adoption[1]
	Administrative support	Cost	Personnel involvement	Duration of the intervention	Format	Technical support	Priority alignment	(Mean ± SD)
1	Minimum	Relatively cheap	High level (e.g. 50%)	Short (e.g. 1 month)	Flexible (internet-based)	Maximum	No	4.00 ± 0.82
2	Maximum	Relatively expensive	High level (e.g. 50%)	Short (e.g. 1 month)	Flexible (internet-based)	Minimum	Yes	2.77 ± 0.96
3	Minimum	Relatively expensive	Low level (e.g. 20%)	Short(e.g. 1 month)	Inflexible (group sessions)	Minimum	No	2.55 ± 0.95
4	Maximum	Relatively cheap	Low level (e.g. 20%)	Short (e.g. 1 month)	Inflexible (group sessions)	Maximum	Yes	3.90 ± 0.84
5	Maximum	Relatively expensive	Low level (e.g. 20%)	Long (e.g. 3 months)	Flexible (internet-based)	Maximum	No	2.75 ± 0.99
6	Minimum	Relatively cheap	Low level (e.g. 20%)	Long(e.g. 3 months)	Flexible (internet-based)	Minimum	Yes	3.27 ± 0.90
7	Minimum	Relatively expensive	High level (e.g. 50%)	Long(e.g. 3 months)	Inflexible (group sessions)	Maximum	Yes	2.37 ± 0.86
8	Maximum	Relatively cheap	High level (e.g. 50%)	Long(e.g. 3 months)	Inflexible (group sessions)	Minimum	No	3.23± 1.03

[1]The likelihood of adoption is presented based on the 5-point Likert-scale from “1 = highly unlikely”, “2 = somewhat unlikely”, “3 = neutral”, “4 = somewhat likely”, to “5 = highly likely”.

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Table 2.

Sample Characteristics

Hospital characteristics (N = 30)			Hospital director characteristics (N = 60)		
Hospital type	Number	%	Gender	Number	%
General hospital	23	76.7	Male	47	78.3
Specialized hospital	7	23.3	Female	13	21.7
Hospital level			Age		
Provincial	10	33.3	45 years or younger	14	23.3
City	10	33.3	46 to 50 years	17	28.3
County	10	33.3	51 years or older	29	48.3
Number of bed			Education		
Less than 500	10	33.3	Associated degree	2	3.3
501-1000	8	26.7	Bachelor’s degree	52	86.7
More than 1000	12	40.0	Graduate degree	6	10.0
Provide antiretroviral therapy			Years of service in the hospital		
Yes	14	46.7	Less than 20 years	21	35.0
No	16	53.3	21 to 30 years	32	53.3
Number of HIV cases in the past year			More than 30 years	7	11.7
10 or under	11	36.7	Professional title		
11-30	11	36.7	Intermediate professional title	13	21.7
31 or above	8	26.7	Vice senior professional title	46	76.7
If participated WW Intervention			Senior professional title	1	1.7
Intervention hospital	6	20.0	Position		
Control hospital	3	10.0	Deputy director	53	88.3
Did not participate	21	70.0	Director	7	11.7

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Table 3.

The Impact Scores of the Intervention Attributes

Attributes ***Levels***	**Estimate (Impact score)**	**P-value**	**Rank**
Administrative support *Maximum vs. minimum*	0.26	0.1285	5
Cost *Cheap vs. expensive*	2.12	<.0001	**1**
Personnel involvement *Low vs. high*	0.04	0.8092	7
Duration of the intervention *Short vs. long*	0.88	<.0001	**2**
Format *Flexible vs. inflexible*	0.36	0.0368	**4**
Technical support *Maximum vs. minimum*	0.69	<.0001	**3**
Priority alignment *Yes vs. no*	−0.16	0.3557	6