Implementation Science: Framework, Challenges, and Multidisciplinary Approaches

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What is implementation science?

- Studies the processes and procedures that promote the transfer of evidence-based intervention into real-world settings

AKA: Dissemination and Implementation Research

- **Dissemination**: spreading evidence-based intervention to the audiences in the targeted settings
- **Implementation**: understand how to effectively deliver an evidence-based intervention within a particular setting

Stages of implementation science

- Exploration stage:
  - Identify the need
  - Assess the fit of a new practices with the system
- Installation stage:
  - Implementation team training/define the responsibilities
  - Develop detailed implementation plan
  - Assure resources and support
- Implementation stage
  - Balance between adaptation and fidelity
  - Strategies to identify and break through bottlenecks
- Expansion and scale-up stage
  - Summarize lessons learned
  - Study mechanisms to sustain the effort

Distinction between implementation science and traditional efficacy trial

Traditional efficacy trial	Implementation science research
Under optimal or laboratory conditions (ideal settings)	In real-world settings
Quantitative	Qualitative or mixed-method
Random allocation of participants	Natural experimental design or quasi-experimental design (less controlled)
Control for confounders	Take into account moderators and mediators
Focus on outcome	Focus on process (implementation indicators)
Internal validity	External validity (generalizability)

Implementation science challenges

- New field:
  - Little consensus on optimal scientific methodology and terminology
  - Measurement issue
  - Lack of agreement on definitions of constructs and measures
- Complexity:
  - Multilevel factors (e.g., policies, work processes culture and regulations, employees, technology etc.)
  - Multidisciplinary (economics, social science, public health, marketing, public policy etc.)
- Insufficient sample size

Case study

RCT "White Coat, Warm Heart (WW)"

- 1760 service providers from 40 county hospitals in two provinces of China
- Aim: to reduce service providers' stigmatizing attitudes and behaviors towards PLH
- Intervention:
  - Identified the trained popular opinion leader providers to disseminate intervention message
  - Provide universal precaution supplies
- Outcome:
  - Significantly reduced prejudicial attitude and avoidance intent towards PLH at 6- and 12-month

Li L, Wu Z, Liang L-J, Lin C, Guan J, Jia M, et al. Reducing HIV-Related Stigma in Health Care Settings: A Randomized Controlled Trial in China. American Journal of Public Health, 2013, 103 (2), 286-292

Study questions

- Hospital gatekeepers' preferences and decision-making in adoption of the intervention model
- Heterogeneous across hospitals--Structural bottleneck of intervention implementation

Conjoint analysis

- A statistical technique used in market research, and later applied in research of individual health behavior
- Aim: to determine what feature of a product is most influential on stakeholder's decision making
- Instead of presenting a series of disparate single item feature, we present an array of product attributes, to determine the relative importance of different features

An example of conjoint analysis

- Cellphone plans:
  - Price: 60 dollars/m; 75 dollar/m; 100 dollars/m
  - Minutes: 800 minutes/m; 1500 minutes/m; 4000 minutes/m
  - Reception: excellent; good; average
  - Rollover options: yes or no
- Survey question: Which of the following cell phone plans do you prefer?

Plan	Price	Minutes	Reception	Rollover
A	60 dollars/m	800 minutes/m	Average	Yes
B	75 dollars/m	1500 minutes/m	Excellent	Yes
C	100 dollars/m	4000 minutes/m	Good	No

Application in implementation science

- To model stakeholders' preferences and decision-making in adoption of the WW intervention model
- Steps:
  - Determine the features (attributes) of the intervention model
  - Generate conjoint scenarios as combinations of attributes
  - Present the scenarios and have respondents rate each scenrario
  - Data analysis

Attributes

- The attributes and levels were determined based on the findings from literature review and in-depth interviews with healthcare administrators and hospital directors
- Seven attributes: administrative support, cost, personnel involved, format and duration of the training, availability of technical support, and if reducing stigma is a priority of the healthcare facility
- Two levels for each attribute to avoid complexity

Scenarios

- $2^7 = 128$ possible scenarios
- To avoid complexity, we use Fractional factorial orthogonal design to yield 8 scenarios
- SAS macro to create efficient factorial designs :

```
%mktex(2 2 2 2 2 2 2, n=8)
%mktlab(vars=A B C D E F G , out=sasuser.design)
%mkteval;

proc print data=sasuser.design;
run;
```

- Output

Obs	A	B	C	D	E	F	G
1	2	2	2	2	1	1	1
2	1	1	2	2	1	2	2
3	2	1	1	2	2	2	1
4	1	2	1	2	2	1	2
5	1	1	1	1	1	1	1
6	2	2	1	1	1	2	2
7	2	1	2	1	2	1	2
8	1	2	2	1	2	2	1

WW intervention scenarios

WW intervention scenarios	Attributes						
	Administrative support	Cost	Personnel involved	Duration of the training	Format	Availability of technical support	Priority of reducing stigma
1	Minimum	Relatively cheap	50%	Short (e.g. 1-month)	Flexible (internet-based)	Maximum	No
2	Maximum	Relatively expensive	50%	Short (e.g. 1-month)	Flexible (internet-based)	Minimum	Yes
3	Minimum	Relatively expensive	20%	Short (e.g. 1-month)	Inflexible (group sessions)	Minimum	No
4	Maximum	Relatively cheap	20%	Short (e.g. 1-month)	Inflexible (group sessions)	Maximum	Yes
5	Maximum	Relatively expensive	20%	Long (e.g. 3-month)	Flexible (internet-based)	Maximum	No
6	Minimum	Relatively cheap	20%	Long (e.g. 3-month)	Flexible (internet-based)	Minimum	Yes
7	Minimum	Relatively expensive	50%	Long (e.g. 3-month)	Inflexible (group sessions)	Maximum	Yes
8	Maximum	Relatively cheap	50%	Long (e.g. 3-month)	Inflexible (group sessions)	Minimum	No

Participants

- Sample size: Given the semi-qualitative nature of conjoint analysis, we proposed to recruit 60 hospital directors.
- Participants recruited from different levels and types of healthcare facilities
  - 1/3 from provincial level hospitals, 1/3 from city level hospitals, 1/3 from country level hospitals
  - 2/3 from general hospital, 1/3 from specialized hospitals
  - About 10 from WW intervention hospitals
- Eligibility: 18 years and above, and be a director (or associated director) of a hospital in the study area
- Selection: based on the leadership recommendation and knowledge of related policy/practise
- Voluntary and informed consent

Scenario administration

- One-on-one face-to-face
- First introduce the purpose, design, and outcome of the WW intervention
- Present eight intervention scenarios using a set of answer cards
- Participants will be asked to rate each scenario in terms of the possibility to adopt the program in the healthcare facilities
- Five categories ratings: “Highly likely”, “Somewhat likely”, “Neutral”, “Somewhat unlikely”, and “Highly unlikely”
- Query feasibility of administering conjoint scenarios

Answer cards

Data analysis

- Transform the ratings into a 0–100 acceptability scale, with 'highly likely' scored as 100 and 'highly unlikely' scored as 0
- For each respondent, a multiple regression model is fit to their acceptability scores Y_i for the eight hypothetical scenarios, i = 1, .., 8; the seven attributes A_p, p = 1, .., 7, serve as independent variables in the model:

$$Y_i = ß_0 + \Sigma ß_p A_p + \varepsilon_i$$

where Σ is a summation over the seven regression coefficients ßp and attributes and εi is a residual error term.

- The regression coefficient for each attribute is the impact score of the attribute on acceptability for the individual respondent

Data analysis

- The impact score for each attribute =mean acceptability score of the four scenarios with the preferred value - mean acceptability score of the four scenarios with the non-preferred value
- Impact of an attribute =average of the individual impact scores across respondents
- One-sample t-test to determine the statistical significance of the impact of each attribute

Data analysis

- Explore the relationship between decision making with
  - Demographic characteristics: age, gender, education, title, duration of service
  - Hospital characteristics: size, level, and type of hospital, HIV caseload, provision of HIV-related services
  - Perception of the WW intervention: relevance, relative advantage, simplicity
  - Perception of inner setting: organizational readiness to change, available resources
  - Perception of the outer setting: policy, availability of technical support

Bottleneck analysis

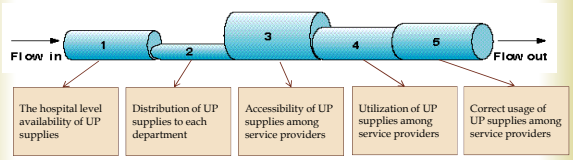
- Originally a computer simulation method, and later used in healthcare management studies
- Aim:
  - To identify the weak links (bottlenecks) in improving universal precaution (UP) compliance among service providers
  - To provide information for choosing a specific way to remove such bottleneck

Study hospitals

- Bottleneck analysis is a case-oriented approach, with each hospital being a case.
- 12 hospitals
  - Two provincial level hospitals, 4 city level hospitals and 6 county level hospitals
  - ½ general hospitals; and ½ specialized hospitals

Links of universal precaution

- Predetermined based on literature review and prior knowledge of hospital system
- Focus group will be conducted with hospital stakeholders to determine the hospital-specific UP throughput in a graphical way



The hospital level availability of UP supplies	Distribution of UP supplies to each department	Accessibility of UP supplies among service providers	Utilization of UP supplies among service providers	Correct usage of UP supplies among service providers

Data collection

- Hospital stakeholder focus group and hospital stock documentations
  - Hospital budget for UP supplies, channel of replenish, and the price for UP supplies
  - Allocation of UP supplies in each department, and the actual amount of supplies that is needed
- Service provider survey and staff observation
  - Amount of UP supplies needed/fulfilled
  - UP compliance
  - Correct usage of UP supply

Data analysis

- Estimate the proportion of fulfillment through each link of the throughput, using a Microsoft Excel-based spread-sheet.
- The link(s) with the least throughput rate will be identified as system "bottlenecks"
  - For example, in a certain hospital:
    The availability of UP supplies is 50% at the hospital level
    80% of the supplies are timely distributed to the departments
    The actual access to the supplies is 40% fulfilled
    About 10% of the providers actually used the supplies ← **BOTTLENECK**
    Among whom 80% used the supplies correctly
- What-if analysis will be conducted to examine the impact of hypothetical changes in UP throughput

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