Changes in Stroke Awareness among Undergraduate Students after an Educational Intervention

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Abstract-

Objective: This study investigated undergraduates' awareness about stroke, the effects of an educational intervention and the difference of measuring tests between recognition and recall.

Methods: We chose a convenient sample from two classes. One of the classes, the recognition group, was tested by a close-ended questionnaire with multiple choices. The other class, the recall group, was tested via an open-ended questionnaire. Participants completed their pretest and first posttest before and right after the education intervention. Twelve weeks after the intervention, participants were tested again to assess the knowledge retention over time.

Results: Fifty six participants in the recognition group and 53 participants in the recall group completed all three tests. Before the intervention, all respondents in the recognition group could recognize three or more risk factors and at least one warning sign, but in the recall group were only 32% and 72% respectively. After the intervention, the mean scores of first posttest and second posttest were all significant higher than that of pretest in both groups ($P < 0.001$). Comparisons of mean score of same items in both groups, the mean score of recognition group was significantly higher than that of recall group at each test (all $P < 0.001$).

Conclusion: The intervention improved participants' knowledge towards stroke, even twelve weeks later. Participants obtained higher scores with a close-ended questionnaire than those with an open-ended questionnaire.

Key Words: stroke, education, risk factors, warning signs, questionnaire

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INTRODUCTION

Cerebrovascular disease is the second leading cause of death worldwide[(1)], and it has been the second or third leading cause of death for two decades in Taiwan[(2)]. Cerebrovascular disease also causes about 3% of Taiwan's health expenditures each year[(3)]. Since healthcare resources are limited, it would be better to consider

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how to effectively prevent stroke occurrence.

Researches have indicated that to a certain extent stroke is preventable[4]. People can lower the risk of stroke via behavioral changes such as healthy diet, proper physical exercise and quitting smoking. But, previous studies have shown that lay people have limited knowledge regarding stroke risk factors, warning signs and response to warning signs[5-10]. Insufficient knowledge of stroke as a serious and treatable disease and response to warning signs was one of the main reasons against early arrival at a hospital for acute stroke treatment[8,11].

Educational interventions improved the knowledge of stroke among the school-aged children and community[11-15], but education effect faded away with time[11,13,14]. However, the effectiveness of stroke prevention educational program for undergraduates is unknown. Besides, most university students do not live with their parents and are self-determined regarding what to do (e.g., diet, activity pattern, smoking or not). It is a critical time period that they can be educated to learn about health behaviors before entering the work force and forming their living style.

This study aimed to investigate undergraduates' awareness about stroke and examine whether the educational intervention can increase undergraduates' knowledge of stroke or not. Accurately assessing the undergraduates' knowledge of stroke is essential to evaluate the effects of educational intervention. Previous assessments of stroke knowledge used either an open-ended[5,8,9] questionnaire or a close-ended questionnaire with multiple choices[7,13,15,16]. An open-ended format is a recall test, in which respondents write down as many items as they can. A close-ended with multiple choices format is a recognition test, in which respondents select all correct items from a list[17]. Those using a recognition format have tended to find higher levels of knowledge than those using a recall format[18]. Therefore, this study addresses three questions: (1) Can undergraduate' awareness about stroke be improved by an educational intervention? (2) Does education effect on undergraduates decline with time? (3) Will participants using a close-ended questionnaire get higher scores than those using an open-ended questionnaire?

METHODS

Setting and Participants

At the beginning of Fall Semester 2007, 9694 undergraduate students enrolled in one campus of a university in Taiwan. The university had nine schools but no medical school. An 18-week course called 'Introduction to Common Diseases' was offered by the General Education Center and open to all students. The teacher of the two classes of this course informed students about the course curriculum and study plan. Students had eight days to decide if they were going to add or drop this course and replace with any other courses. After the add/drop period, 138 students still in the above two classes (with a maximum of 140 students) were chosen as participants of this study.

Seventy participants in one class, the recognition group, were tested by a close-ended questionnaire with multiple choices. Sixty eight participants in the other class, the recall group, were tested via an open-ended questionnaire. Both recognition and recall groups were respectively exposed to the same educational intervention that was designed and lectured by the same teacher. Participants completed their pretest and first posttest in class before and right after the stroke education intervention at 17 October 2007. Twelve weeks after the intervention, participants were tested again to assess the knowledge retention of stroke over time.

Educational Intervention

The educational intervention consisted of a video and a lecture with slides to introduce the knowledge of stroke. The title of the video is 'The Body Invaders: Brain Attack', which was published by Discovery Channel. The video is English pronounced with Chinese subtitle. The video first explained the cause of ischemic and hemorrahage stroke. Second, it illustrated the treatment of r-tPA with a patient within 3 hours of stroke onset. Third, five stroke warning signs was demonstrated by an actor. Fourth, it presented the risk factors such as hypertension, diabetes, heart diseases, improper diet, lack of exercise and smoking via actual cases. Lastly, it showed three stroke patients' rehabilitation programs.

After 34-mimute video show, the teacher gave 16-minute lecture with 5 slides. The lecture comprised of 5 sections: (1) pathophysiology of stroke; (2) the established 8 stroke risk factors including high blood pressure, high blood cholesterol, heart disease, cigarette smoking, diabetes mellitus, obesity, age and history of stroke[4,19,20]; (3) preventing stroke by taking exercise, appropriate BMI, proper diet, quitting smoking, good control of hypertension/diabetes/high cholesterol; (4) five stroke warning signs currently adopted by the Taiwan Stroke Association and the American Stroke Association (ASA); and (5) the whys for calling 119 (emergency call number in Taiwan) immediately when seeing someone with stroke warning signs.

The reasons for introducing only eight stroke risk factors instead of all stroke risk factors listed in the ASA guideline4 are: (1) too many risk factors may be difficult for undergraduates to remember, (2) about 60% to 80% of all ischemic strokes can be attributed to increasing blood pressure, blood cholesterol, cigarette smoking, carotid stenosis, diabetes mellitus, atrial fibrillation, valvular heart disease19, and (3) carotid stenosis is arguably not a major risk factor of stroke in Taiwan[20,21].

Questionnaires and Outcome Measures

The effectiveness of educational intervention for undergraduates was assessed using a pretest, first posttest and second posttest design. The questions (in Chinese) in these tests were as follows:

1. Which organ in the body does a stroke attack?
2. What are the risk factors of stroke?
3. What are the warning signs of stroke?
4. What would you do if someone you knew is having a stroke?

Besides, participants' age, gender, and ever received stroke information were also asked. With these questions, an open-ended and a close-ended questionnaire were developed by a health teacher experienced in educating undergraduates and a stroke researcher. The preliminary version of the questionnaires had been assessed for content validity by a neurologist and subsequently modified.

If the answers to the questions were identical to the messages highlighted on the slides, they were treated as "correct" and scored. For example, brain was the correct answer in question 1. For question 2, correct answers of 8 stroke risk factors were heart disease, cigarette smoking, hypertension, high blood cholesterol, obesity, diabetes, age, and history of stroke[4,19,20]. For question 3, correct answers of 5 stroke warning signs were: (1) sudden numbness or weakness of the face, arm or leg, especially on one side of the body, (2) sudden confusion, trouble speaking or understanding, (3) sudden trouble seeing in one or both eyes, (4) sudden trouble walking, dizziness, loss of balance or coordination, and (5) sudden severe headache with no known cause. In question 4, 'calling 119' or 'rushing to hospitals' were the correct responses. Answers to the questions not conforming to the aforementioned correct answers were considered as incorrect responses. Each correct response received 1 point and incorrect responses received 0 points. Therefore, the maximum score of the open-ended questionnaire was[15].

In the close-ended questionnaire, question 1 was 1 of 5 response options, question 2 included 8 stroke risk factors and 2 non-stroke risk factors, question 3 provided 5 stroke warning signs and 3 non-stroke warning signs, and question 4 was 1 of 4 response options. Left non-stroke risk factors and non-stroke warning signs unmarked were also correct responses because question 2 and question 3 were multiple choices. The maximum overall score of the close-ended questionnaire was 20. In order to investigate whether the same items requiring only recognition produced higher scores than those which required a recall, the other score rule did not include the unmarked non-stroke risk factors and non-stroke warning signs and therefore the maximum score of the close-ended questionnaire was 15, which was the same as the maximum score of the open-ended questionnaire. For the purpose of double check, coding was done independently by two authors.

Statistical Analysis

Descriptive statistics were used to present the mean scores and standard deviations of the three tests, and the frequencies and percentages of the responses to each

answer items of questions. In order to find if the educational intervention can improve participants' knowledge or not, the mean scores of three tests were tested by repeated measure one-way ANOVA. Comparisons of mean score between recognition and recall groups at each test were assessed by t test. Stata 8.0 and SPSS 14.0 for Windows were used for the analyses. Statistical significance was set at $P < 0.05$.

RESULTS

There were 70 participants in the recognition group and 68 participants in the recall group. Participants were included in the analysis only if they completed all three tests. Overall, 56 participants in the recognition group and 53 participants in the recall group were included in the analysis. In the recognition group, the average age was 22 years (range 19-26 years) and 39% was female and 61% ever received stroke information. As for recall group, the average age was also 22 years (range 20-24 years) and 77% was female and 42% ever received stroke information (Table 1).

In recognition group, the differences in mean score between pretest and first posttest ($F = 248.62$), first posttest and second posttest ($F = 102.92$), pretest and second posttest ($F = 77.76$) were all significant (all $P < 0.001$). In recall group, the differences in mean score between pretest and first posttest ($F = 1063.68$), first posttest and second posttest ($F = 143.82$), pretest and second posttest ($F = 330.03$) were also all significant (all $P < 0.001$). The results indicated that the educational intervention indeed improved participants' knowledge towards stroke, even twelve weeks later. However, the education effects faded away with time (Table 1).

Among each group of participants, those who ever received stroke information obtained higher mean scores than those reporting none at each test except first posttest in the recall group; however, the differences were not statistically significant. Female participants in the recall group had higher mean score than male ones at each test, but they performed less well in the recognition group. Such differences between female and male participants were also not statistically significant, except for the first posttest result in the recall group (Table 1).

Table 1. *Mean Scores in both Recognition and Recall Groups*

	Respondents	Pretest	First Posttest	Second Posttest
	n (%)	Mean (SD)	Mean (SD)	Mean (SD)
Recognition group	56 (100)	14.8 (1.79)	19.2 (0.99)	17.4 (1.40)
Gender				
Male	34 (61)	15.0 (1.92)	19.2 (0.88)	17.5 (1.42)
Female	22 (39)	14.5 (1.57)	19.1 (1.17)	17.2 (1.37)
Ever received stroke info.				
Yes	34 (61)	15.1 (1.56)	19.2 (0.92)	17.5 (1.33)
No	22 (39)	14.4 (2.09)	19.1 (1.11)	17.3 (1.52)
Recall group	53 (100)	4.5 (1.76)	13.6 (1.48)	9.9 (2.39)
Gender				
Male	12 (23)	3.8 (1.95)	12.7 (1.97)	9.1 (2.27)
Female	41 (77)	4.7 (1.68)	13.9 (1.20)	10.2 (2.39)
Ever received stroke info.				
Yes	22 (42)	5.1 (1.99)	13.6 (1.50)	10.0 (2.26)
No	31 (58)	4.1 (1.49)	13.7 (1.50)	9.9 (2.51)

The maximum scores of both recognition and recall groups were 20 and 15 respectively. The differences of mean score between pretest and first posttest, first posttest and second posttest, pretest and second posttest were all significant in both recognition and recall groups (all $P < 0.001$).

Stroke awareness in the recognition group was good (Table 2). Before the intervention (pretest), the percentage of each correct option was at least 50% except cigarette smoking (34%) as a stroke risk factor and trouble seeing (36%) as a stroke warning sign. Right after the intervention (first posttest), the percentage of each correct option was at least 91%. In contrast to the recognition group, the overall knowledge of stroke among the recall group was limited (Table 3). In the pretest, the percentage of each correct answer was less than 50% except

Table 2. *Stroke Awareness in the Recognition Group (n = 56)*

	Pretest Frequency (%)	First Posttest Frequency (%)	Second Posttest Frequency (%)
Q1. Where a stroke occurs-brain	46 (82)	56 (100)	55 (98)
Q2. Stroke risk factors			
Heart disease	32 (57)	53 (95)	48 (86)
Cigarette smoking	19 (34)	56 (100)	49 (88)
Hypertension	54 (96)	56 (100)	56 (100)
High blood cholesterol	56 (100)	56 (100)	55 (98)
Obesity	52 (93)	51 (91)	56 (100)
Diabetes	29 (52)	54 (96)	51 (91)
Age	40 (71)	56 (100)	53 (95)
History of stroke	54 (96)	56 (100)	55 (98)
Number known of risk factors			
≥ 3 stroke risk factors	56 (100)	56 (100)	56 (100)
≥ 6 stroke risk factors	36 (64)	56 (100)	53 (95)
Nonstroke risk factors			
Myopia	0 (0)	0 (0)	2 (4)
Liver disease	2 (4)	1 (2)	8 (14)
Q3. Stroke warning signs			
Sudden numbness	55 (98)	56 (100)	55 (98)
Sudden headache	28 (50)	55 (98)	43 (77)
Sudden trouble seeing	20 (36)	56 (100)	48 (86)
Sudden difficulty in speaking	44 (79)	55 (98)	55 (98)
Sudden loss of balance	42 (75)	55 (98)	54 (96)
Number known of warning signs			
None	0 (0)	0 (0)	0 (0)
1 stroke warning sign	3 (5)	0 (0)	0 (0)
2 stroke warning signs	6 (11)	0 (0)	0 (0)
3 stroke warning signs	23 (41)	0 (0)	6 (11)
4 stroke warning signs	15 (27)	3 (5)	13 (23)
5 stroke warning signs	9 (16)	53 (95)	37 (66)
Nonstroke warning signs			
Shortness of breath (lack of sudden)	18 (32)	8 (14)	24 (43)
Cramp (lack of sudden)	16 (29)	5 (9)	23 (41)
Stiff neck (lack of sudden)	38 (68)	19 (34)	37 (66)
Q4. Behavioral intent to call 119	52 (93)	56 (100)	55 (98)

for stroke attacking brain (77%), calling 119 for stroke (91%), and hypertension (53%) as a stroke risk factor. In the first posttest, at least 74% of respondents could provide all correct answers. The percentage of the same item was higher in the recognition group than in the recall group at each test except behavioral intent to call 119 in second posttest (Table 2 and 3). Generally speaking, the frequencies and percentage of each correct option/answer was the lowest in the pretest and the highest in the first posttest, with that of 12-week follow-up

Table 3. *Stroke Awareness in the Recall Group (n = 53)*

	Pretest Frequency (%)	First Posttest Frequency (%)	Second Posttest Frequency (%)
Q1. Where a stroke occurs-brain	41 (77)	53 (100)	52 (98)
Q2. Scored stroke risk factors			
Heart disease	13 (25)	47 (89)	37 (70)
Cigarette smoking	6 (11)	49 (93)	34 (64)
Hypertension	28 (53)	53 (100)	44 (83)
High blood cholesterol	15 (30)	43 (81)	19 (36)
Obesity	15 (30)	39 (74)	34 (64)
Diabetes	7 (13)	51 (96)	27 (51)
Age	7 (13)	40 (76)	22 (42)
History of stroke	3 (6)	46 (87)	21 (40)
Number known of Risk factors			
None	12 (23)	0 (0)	1 (2)
≥ 3 stroke risk factors	17 (32)	53 (100)	47 (89)
≥ 6 stroke risk factors	0 (0)	46 (87)	19 (36)
Nonscored stroke risk factors			
Genetic	4 (8)	1 (2)	9 (17)
Improper diet	25 (47)	19 (36)	19 (36)
Physical inactivity	8 (15)	2 (4)	7 (13)
Alcohol abuse	14 (26)	1 (2)	24 (45)
Q3. Stroke warning signs			
Sudden numbness	21 (40)	47 (89)	41 (77)
Sudden headache	9 (17)	50 (94)	25 (47)
Sudden trouble seeing	1 (2)	53 (100)	39 (74)
Sudden difficulty in speaking	6 (11)	50 (94)	45 (85)
Sudden loss of balance	18 (34)	48 (91)	32 (60)
Number known of warning sign			
None	15 (28)	0 (0)	0 (0)
1 stroke warning sign	24 (45)	0 (0)	1 (2)
2 stroke warning signs	12 (23)	0 (0)	7 (13)
3 stroke warning signs	1 (2)	3 (6)	20 (38)
4 stroke warning signs	1 (2)	11 (21)	18 (34)
5 stroke warning signs	0 (0)	39 (74)	7 (13)
Q4. Behavioral intent to call 119	48 (91)	53 (100)	53 (100)

Table 4. *Mean Scores of the Same Items in both Recognition and Recall Groups*

	Whole sample (n = 109)		
	Recognition (n = 56)	Recall (n = 53)	t (P)
	Mean (SD)	Mean (SD)	
Pretest	11.13 (1.95)	4.49 (1.76)	18.58 (< 0.001)
First Posttest	14.77 (0.54)	13.62 (1.48)	5.30 (< 0.001)
Second Posttest	14.07 (1.20)	9.91 (2.39)	11.40 (< 0.001)
Progress	2.95 (2.15)	5.42 (2.17)	-5.96 (< 0.001)
	Ever received stroke info.(n = 56)		
	Recognition (n = 34)	Recall (n = 22)	t (P)
	Mean (SD)	Mean (SD)	
Pretest	11.65 (1.63)	5.05 (1.99)	13.57 (< 0.001)
First Posttest	14.82 (0.46)	13.59 (1.50)	3.74 (= 0.001)
Second Posttest	14.15 (1.18)	9.95 (2.26)	8.03 (< 0.001)
Progress	2.50 (2.02)	4.91 (2.11)	-4.28 (< 0.001)
	Never received stroke info.(n = 53)		
	Recognition (n = 22)	Recall (n = 31)	t (P)
	Mean (SD)	Mean (SD)	
Pretest	10.32 (2.17)	4.10 (1.49)	12.39 (< 0.001)
First Posttest	14.68 (0.65)	13.65 (1.50)	3.43 (= 0.001)
Second Posttest	13.95 (1.25)	9.87 (2.51)	7.79 (< 0.001)
Progress	3.64 (2.22)	5.77 (2.17)	-3.50 (= 0.001)
	Male (n = 46)		
	Recognition (n = 34)	Recall (n = 12)	t (P)
	Mean (SD)	Mean (SD)	
Pretest	11.18 (1.93)	3.83 (1.95)	11.31 (< 0.001)
First Posttest	14.71 (0.63)	12.67 (1.97)	3.52 (= 0.004)
Second Posttest	14.06 (1.23)	9.08 (2.27)	7.21 (< 0.001)
Progress	2.88 (1.97)	5.25 (2.80)	-3.20 (= 0.003)
	Female (n = 63)		
	Recognition (n = 22)	Recall (n = 41)	t (P)
	Mean (SD)	Mean (SD)	
Pretest	11.05 (2.03)	4.68 (1.68)	13.30 (< 0.001)
First Posttest	14.86 (0.35)	13.90 (1.20)	4.76 (< 0.001)
Second Posttest	14.09 (1.19)	10.15 (2.39)	8.73 (< 0.001)
Progress	3.05 (2.46)	5.46 (1.99)	-4.23 (< 0.001)

The maximum scores in both recognition and recall groups were 15 because only same items in both groups were scored.
The progress means score of second posttest minus score of pretest.

test (second posttest) being in-between in both groups.

Comparisons of the mean score of the same items in both groups (Table 4) showed the mean score of recognition group was significantly higher than that of recall group at each test (all $P < 0.001$). This was also true between male and female participants and between those who ever and never received stroke information. Besides, we measured the change, i.e. the mean score of

second posttest minus the score of pretest. The mean change of the score in the recall group was significantly higher than that in the recognition group, regardless of gender or prior stroke information.

DISCUSSION

Our study showed that the educational intervention could significantly improve undergraduates' knowledge towards stroke, even twelve weeks later. No matter what questionnaire type is, the scores are significantly improved after the intervention (Table 1), which is in line with other studies[11-15]. However, the mean score declined significantly in the second posttest. This result implied that education effect faded with time, which was also consistent with the results in previous studies [11,13,14]. How to maintain participants' knowledge of stroke is therefore crucial.

The percentage of each correct option/answer was higher in the recognition group than in the recall group at almost all test items (Table 2 and 3). Before the intervention, all respondents in the recognition group could recognize three or more risk factors and at least one warning sign (Table 2), but the percentages of respondents in the recall group knew none risk factors, three or more risk factors and at least one warning signs were 23%, 32%, and 72% respectively (Table 3). These results of the recall group were similar to the results of a study from Czech Republic, i.e. 26%, 19%, and 78% respectively 8, and the results from Brazil, i.e.18.5%, 39.5%, and 78% respectively[9]. Twelve weeks after the intervention, the percentage of each correct answer for stroke risk factors in the recall group ranged between 36 and 83, but that in the recognition group ranged between 86 and 100 which was akin to the results of one German study[16].

The mean score of the recognition group was significantly higher than that of the recall group at each test (Table 4), regardless of prior information of stroke or gender. These results implied that the participants could obtain higher scoring of stroke knowledge by using close-ended questionnaire than open-ended questionnaire. The reasons may be as follows: (1) Recognition tests present items to the respondents and can lead to guessing. (2) The cognitive processes involved in recall are more complex than those involved in recognizing the correct response[18]. (3) The close-ended questionnaire in the first posttest and second posttest could remind respondents of the messages introduced by the intervention again and again.

Furthermore, we measured the progress, i.e. the mean score of second posttest minus the score of pretest. The mean progress of recall group was significantly higher than that of recognition group (Table 4), regardless of gender or prior knowledge of stroke information. This is because the mean score of recall group in the pretest was the lowest and, therefore, had the most space for improvement.

Which format of questionnaire might be more appropriate to assess stroke knowledge? The close-ended questionnaire with a list of items as a cue may be proper to assess stroke warning signs because it resembles a real life situation where the sign itself will act as a cue for help-seeking behavior. Avoiding risk factors are seldom present in daily life, and therefore the open-ended questionnaire without a list of items may be proper to assess the stroke risk factors[18].

The results of the pretest are important for designing the contents of educational interventions. For instance, only 34% of respondents of the recognition group and 11% of the recall group knew that cigarette smoking was a stroke risk factor (Table 2 and 3). This may imply that undergraduates were not alert to smoking being a risk factor of stroke. Besides, only 36% of respondents of the recognition group and 2% of the recall group knew that sudden trouble seeing was a stroke warning sign (Table 2 and 3). In light of the deficiency of knowledge revealed by the pretest, implementation of a more targeted intervention aiming to fill in the gap may be worthwhile.

Some respondents in the recall group replying alcohol abuse, improper diet, physical inactivity and genes as risk factors (Table 3). However, alcohol abuse was classified as less well-documented by American Stroke Association (ASA)4, and the direct genetic contribution of any single gene towards ischemic stroke is likely to be modest and apply in selected patients only and in combi-

nation with environmental factors or via other epistatic effects[19]. This was the reason why we did not mention alcohol abuse and genes as risk factors for stroke during the intervention. Although the poor diet and physical inactivity were classified as well documented by ASA4, the causal role of low fruit and vegetable intake, and physical inactivity remain to be proven[19]. For this reason, these two items were listed on the 'how to prevent a stroke' section of the slide instead of 'risk factors' during the intervention. But we did not measure respondents' attitude regarding stroke prevention. This may be the reason for the low percentage of answers we observed.

This study has limitations. To generalize these results to other populations must be careful. We chose a convenient sample from two classes of the 'Introduction to Common Diseases' course instead of a random sample from all undergraduates in the university. Although the course was open to all 9694 students, the convenient sample may have higher interest in information about health issues and therefore may obtain higher mean score than other students. Besides, the number of respondents in each subgroup of gender or prior experience of stroke information was too small to check for interaction effects of individual characteristics and the educational intervention on the outcome measures. Finally, the stroke awareness was measured before, right after and twelve weeks after the educational intervention. Thus, we do not know the educational effect after six months or a year.

In conclusion, there were gaps of stroke knowledge among participants to fill. The educational intervention indeed improved participants' knowledge towards stroke regardless of the questionnaire format, even twelve weeks later. However, the intervention effects faded with time. How to maintain participants' knowledge of stroke is therefore crucial. It seems that we have to take another action to reinforce participants' awareness about stroke. But, when should we reinforce it? Further studies could use random samples, enough participants and more posttests at different time after the intervention to evaluate both immediate and sustained effects of interventions.

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