

# 以綜合分析法量化臨床作業系統和衛生教育介入方案對影響預防保健服務提供的成效

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**目標：**利用綜合分析法量化臨床作業系統和衛生教育介入方案影響預防保健服務的成效。**方法：**首先以設定之關鍵字在MEDLINE, HEALTH STAR, CINALE, DISSERTATION ABSTRACTS, ERIC 和 PSYCH INFO等資料庫中，以四個標準對相關文獻進行篩選：1.發表於1990年代；2.統計結果可以計算成效值；3.包含一或多個預防保健服務項目；4.有實施臨床作業系統或衛生教育介入方案。**結果：**綜合分析後發現，不同的臨床作業系統和衛生教育介入方案對所研究的預防保健服務項目皆有正向的效果。對於「健康諮商」和「預防接種」兩項的效果為中等強度，其成效值界於0.45至0.64及0.26到0.50之間。對於「預防性篩檢」的效果較低，其成效值界於0.07至0.22之間。就介入期程而言，以介入七個月至一年者有最好的成效值。就臨床作業系統或介入方案而言，指導醫師對實習醫師的個案監督與直接回饋的介入效果最好。對「健康諮商」和「預防接種」而言，三種以上的介入比單一或兩種介入的效果為佳。對「預防性篩檢」和「健康諮商」而言，針對病人設計的介入比針對醫師設計的介入成效佳。**結論：**臨床作業系統與衛生教育方案對於提昇預防保健服務的利用率有顯著的成效可獲證實。本研究的結果可供有意推廣預防保健服務的公共衛生計畫參考。(台灣衛誌 2002；21(1)：36-51)

**關鍵詞：**綜合分析、預防保健服務、臨床作業系統、衛生教育介入。

## Effects of office system and educational interventions in increasing the delivery of preventive health services: a Meta-Analysis

**Objectives:** To examine quantitative effect of office system and educational intervention in selected preventive health services (PHS) in primary care practices and whether effectiveness differed by study and intervention characteristics. **Methods:** Fifty studies that conducted office-based interventions for improving PHS were retrieved from various computerized databases. Selected studies were based on the following criteria: (1) published since 1990, (2) contain results on the practices of primary care providers allowing calculation of at least one effect size, (3) data related to one or more of the following classifications of preventive health services: screening, lifestyle counseling and adult immunization, and (4) use office system tools or educational components. **Results:** There were small to medium effects for office system and educational interventions focusing on life style counseling (effect sizes range from 0.45 to 0.64,  $P < 0.0001$ ) and adult immunizations (effect sizes range from 0.26 to 0.50,  $P < 0.0001$ ). However, interventions produced smaller effects for screening tests (effect sizes range from 0.07 to 0.22). Greater success was found for studies lasting 7 to 12 months and using chart audit measurement regardless of the type of preventive health service. With the exception of screening tests, delivery rates improved most when the subjects were the targets of a combination of three or more interventions. Interventions targeting patients were more successful than those targeting providers for screening tests and lifestyle counseling. **Conclusions:** The effectiveness of office system and educational interventions for improving delivery rates is well-supported, especially for lifestyle counseling and adult immunizations. (Taiwan J Public Health. 2002;21(1):36-51)

**Key Words:** meta-analysis, preventive health services, office system, educational intervention.

## Introduction

Preventive health services (PHS) are essential for the health maintenance of medical consumers. However, patients, and providers may encounter a variety of factors/barriers in the delivery of PHS. Significant patient barriers influencing PHS delivery include (1) unequal access due to demographic factors[1,2], (2) lack of knowledge[3] and readiness to receive PHS[4, 5], (4) reason for visit[6], (5) physician visit frequency[7], and (6) lack of insurance coverage [3,8,9]. Critical factors/barriers influencing optimal performance related to the providers include (1) knowledge or attitude regarding PHS [10,11], (2) unfavorable logistics (e.g., time taken) [5,12,13], (3) lack of training and skill[14,15], (4) practice environments that do not facilitate PHS delivery[5]. With regard to the health care system, significant barriers include (1) lack of financial coverage or inadequate reimbursement for PHS[16,17], (2) lack of resources or attention devoted to prevention[18,19], and (3) lack of office system to track performance in prevention [20].

Although there is no panacea to eliminate these factors/barriers, the delivery of PHS can be facilitated by a well-established office system [21]. Office system interventions refer to a set of office system tools was designed to involve office staff and to facilitate delivery of timely, appropriate, and comprehensive PHS. These tools include chart flow sheets, used to document health care and communicate within the preventive team; prevention prescription pads to formalize agreements between patient and provider regarding PHS; reminder post cards for patient outreach; post-it notes to remind clinicians of recommended services; colorful chart stickers highlighting health problems to be addressed at every visit; and a waiting room poster urging

patient requests for prevention[22,23]. Each of these tools is designed to contribute to the office system change needed to achieve appropriate utilization of PHS[23]. In addition, educational interventions refer to offering patients or providers educational materials (manual and handbooks), outreach visits, structured seminars or related educational activities were also frequently applied in clinical settings.

Several previous reviews and meta-analysis of office system and educational interventions to increase PHS have been conducted. McPhee and Detmer's review[24] for cancer preventive services supported the efficacy of office system interventions. Dickey and associates[25] also examined the effectiveness of office system and educational interventions to improve behavior-change counseling in primary care settings. They suggested that the additive improvement in counseling and patient behavior-change rates resulted from the combination of various tools and teamwork approaches. The review of Hulscher and colleagues[26] revealed incongruent findings among studies regarding the effects of interventions on the delivery of preventive services. The Cochrane review group's analysis of PHS review papers noted that multifaceted interventions, educational outreach visits, reminders and interactive educational meetings were consistently effective[27]. These systematic or conclusive review papers supported the effectiveness of office system and/ or educational interventions to increase rates of preventive services. However, they did not provide the relative magnitudes regarding the effectiveness of diverse interventions.

The meta-analysis of Snell and Buck[28] showed that cancer screening activities increased with the implementation of office system and education interventions. Other meta-analytic studies explored the effects of health education on specific behavior changes[29-36]. Based on our current knowledge, no available meta-ana-

投稿日期：90年11月29日

接受日期：91年4月16日

lytic literature explores the use of office system and educational interventions to increase rates of health counseling and adult immunizations. The effect of using reminders to prompt physicians to provide preventive care has been discussed by three studies[37-39]. However, other office system and educational interventions were not included.

The purpose of this meta-analysis is to examine quantitative effect of office system and educational intervention in selected PHS in primary care practices and whether effectiveness differed by study and intervention characteristics.

## Methods

### Reference sources and search procedure

Reviewed English studies which conducted in the United States were retrieved through MEDLINE, HEALTH STAR, CINALE, DISSERTATION ABSTRACTS, ERIC and PSYCH INFO databases by using two groups of medical subject heading (MeSH) terms. These terms included (1) primary prevention, preventive health service, mass screening, counseling, adult immunization, vaccination, cholesterol, mammography, Papanicolaou's test, occult blood, sigmoidoscope, smoking, nutrition, exercise, diphtheria-tetanus-pertussis vaccine, pneumococcal polysaccharide vaccine (pneumovax), influenza vaccine and (2) intervention studies, reminder systems, medical education, patient education. The bibliography of each study was also reviewed for additional references. These searches yielded more than two thousand studies. After reviewing the abstracts of these articles, approximately 100 relevant articles were retrieved. We used the following criteria to select studies: (1) published since 1990, (2) contain required information on the practices of primary care providers for calculating at least one effect size, (3) provide data related to one or more of the following classifications of PHS: screening tests

(activities that intend to detect chronic diseases or cancer early, refer to cholesterol screening, refer to Papanicolaou's test, mammography, breast exam, fecal occult blood test, sigmoidoscopy), lifestyle counseling (any combination of learning experiences designed to facilitate actions conducive to health, refer to smoking, nutrition and exercise counseling), and adult immunization (activities that vaccinate patients to keep them from preventable diseases, refer to tetanus-diphtheria, pneumovax, influenza), and (4) use defined office system tools or educational materials. Fifty retrieved studies[40-89] matched by the criteria were manually coded by two authors (GJL and CMH). A paired comparison of coding of 10 reports indicated an agreement level of 85% of the total items coded. Discrepancies in coding were resolved by a series of research meetings.

### Characteristics of studies and interventions

Study characteristics include data source, sample selection, study design, intervention period and study population. Data source was coded as chart audit or self-report. Sample selection was coded as randomized or not randomized. Study design was coded using controlled trial or pre- and post-test. The categories of intervention period were consisted of 6 months or less, 7 to 12 months, and more than one year. The categories of study population included patients from single setting, patients from multiple settings and patients from health maintenance organization (HMO).

Intervention characteristics include number of interventions, target of intervention, places of interventions and types of interventions. Number of interventions refers to the number of interventions used in the study. Target of interventions was classified into four categories: provider-focused, patient-focused, nurse- or staff-focused and two targets or more. Place of interventions refers to the place where the interven-

tion was conducted with during (medical) visit (e.g., flowsheet, computer or manual reminder), outside visit (e.g., patient or provider education, audit with feedback), combination of during- and outside-visit interventions. Type of interventions refers to seven categories including flowsheet use, computer reminder, audit with feedback, patient or provider education, patient-held mini record or health diary, manual reminder, and follow-up call. Types of intervention were coded as no use or use.

## Analysis

The SPSS-PC[90] was used to calculate the mean delivery rates of each clinical preventive service. The meta-analytic software program DSTAT 1.12[91] was employed to compute the effect sizes for each study and to manage the coded data. Effect size has been defined as "the degree to which the phenomenon is present in the population, or the degree to which the null hypothesis is false"[93]. The effect sizes presented in the tables and used in the analysis were all adjusted based on the number of study subjects to avoid overestimating effect size, an issue for very small samples. Mean weighted effect sizes (MWES, represented by  $d +$ ) were based on differences between experimental and control groups in proportions meeting the outcome measure specified by the researchers (e.g., 50% ( $n = 20$ ) and 40% ( $n = 20$ ) of subjects in the experimental and control groups, respectively, received cholesterol screening within the prior five years, see Appendix). Formulae for these effect size calculations and the sample size adjustment can be found in the DSTAT manual[91].

The use of MWES can minimize the mathematical influence of extreme numbers in the original data (e.g., sample sizes, observed proportions of PHS). Studies that have treatment groups with different interventions or that presented findings separately for each PHS ad-

dressed by an intervention yield multiple effect sizes. Each calculated effect size is referred to as a case. Thus, 50 studies generated 208 total cases. In addition, the statistic,  $Q$ , were calculated to test for homogeneity of the true effect correlations across studies[91].

We also presented the MWES with and without outliers for screening test, lifestyle counseling and adult immunization. Outliers were defined as those that would result in heterogeneity based on the results of  $Q$  statistic procedure [91]. Although excluded outliers during meta-analytic processes can keep homogeneity of analyzed studies, but previous meta-analytic studies[28,29] had included outliers while numbers of analyzed studies were limited. We presented both values in this study to show whether the exclusion of outliers would change the statistical conclusions.

To control for publication bias (that studies with negative results are less likely to be published, also called file drawer problem), a sensitivity analysis was performed to assess the potential influence of unidentified negative trials in overturning the results of the study. Calculated tolerance levels were used to compare with the corresponding threshold tolerance levels. Calculated tolerance is defined with the formula  $20k/n$ , where  $k$  is the number of positive studies in a category and  $n$  is the number of studies in this category. A study is viewed as a positive one if there was a significant difference for the intervention group (post-test) compared with the control group (pre-test) at follow-up. Threshold tolerance is the number of unpublished negative studies that could reasonably exist. The Rosenthal formula of  $5n + 10$  has been widely used to calculate threshold tolerance[37,92]. When the calculated tolerance level exceeds the threshold tolerance, it is unlikely that unpublished negative studies could overturn the results.



## Results

Overall, although the effect sizes were not homogeneous ( $Q = 5629.1$ ,  $P < 0.001$ ), office system and educational interventions significantly increased the delivery rates of selected PHS in the 1990s (MWES = +0.26, 95% CI = +0.25/+0.27) (see Table 1). A similar result was obtained after excluding all outliers (MWES = +0.29, 95% CI = +0.27/+0.30;  $Q = 129.131$ ). Cohen pointed out that criteria of effect sizes are classified as small (MWES = 0.2), medium (MWES = 0.5), and large effect (MWES = 0.8) [93]. As shown in Table 1, the MWES for screening tests, lifestyle counseling and adult immunizations were 0.17 (95% CI = +0.16/+0.18,  $P < 0.0001$ ), 0.52 (95% CI = +0.50/+0.54,  $P < 0.0001$ ) and 0.30 (95% CI = +0.29/+0.32,  $P < 0.0001$ ) respectively. After excluding all outliers, the responsive MWES were also positive for differences in the experimental (or post-test) direction ( $p < 0.0001$ ). The respective new weighted effect sizes were 0.12 (95% CI = +0.11/+0.14), 0.46 (95% CI = +0.44/+0.48) and 0.30 (95% CI = +0.27/+0.33). Variation in effect size was found across the PHS within each category, and all confidence intervals were in the positive range.

With regard to the publication bias, the results of calculated tolerance and corresponding threshold tolerance for PHS were showed in Table 1. For example, the calculated tolerance for cholesterol screening was 168 ( $20k - n = 20 \times 9 - 12$ ), however, the corresponding threshold tolerance was 70 ( $5n + 10 = 5 \times 12 + 10 = 70$ ). Because 168 is greater than 70, the unpublished negative cholesterol screening studies will not overturn the current results. We found that all calculated tolerance levels exceeded the corresponding threshold tolerance. Therefore, it is unlikely that unpublished negative studies would overturn these results.

The MWES for study and intervention char-

acteristics are shown in Table 2. Across the three categories of services, greater success was found for studies that used chart audit measurement and lasted 7 to 12 months. The delivery rates improved best for lifestyle counseling and adult immunization when the subjects received three or more interventions. In the studies regarding screening tests (95% CI of MWES, 0.31-0.35 vs. 0.18-0.22) and lifestyle counseling (95% CI of MWES, 0.90-1.00 vs. 0.33-0.43), targeting patients was more successful than targeting providers, while there was little difference by intervention-targeting (95% CI of MWES, 0.39-0.45 vs. 0.40-0.46) for adult immunizations. Screening test was clearly most effective during the visit, while counseling was more effective outside the visit though effective during the visit. No difference was found for adult immunizations occurring during or outside the visit. Very small effect sizes were found for combination interventions for screening tests and adult immunizations.

As shown in Table 3, although the MWES of different types of interventions range from 0.06 to 0.59, they are all in the positive direction. These effect sizes are classified as small (MWES = 0.2) or medium (MWES = 0.5) effects. Audit with feedback targeting resident physicians in two studies revealed the best effect for PHS (MWES = 0.59). The use of computer and manual reminders and combination interventions of education and some type of office system tools (e.g., patient-held health diary or mini-record, computer reminder, and flowsheet) produced small to medium effects. However, three or more interventions produced small effects.

## Discussion

The results of this study document that office system and educational interventions can significantly increase the delivery rates of screen-

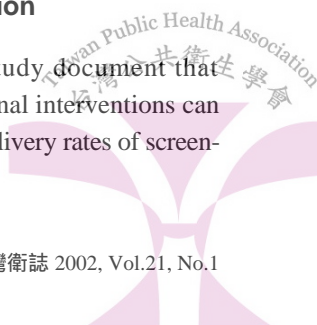




Table 1. Mean weighted effect size (MWES) by clinical preventive service

[illegible]

E: experimental group or post-test; C: control group or pre-test; CI: confidence interval.

Table 2. Mean weighted effect sizes, number of cases and 95% CI of MWES for study and intervention characteristics

Study Characteristics Data Source	Screening Test			Lifestyle Counseling			Adult Immunization		
Sample Allocation	Chart audit	0.18	123	0.17/ 0.19	0.53	20	0.51/ 0.55	49	
	Self-report	0.13	11	0.11/ 0.15	0.36	5	0.27/ 0.44	NA	0
Study Design	Randomized	0.13	101	0.12/ 0.14	0.76	14	0.72/ 0.79	0.40	0.38/ 0.43
	Not Randomized	0.23	33	0.21/ 0.25	0.44	11	0.42/ 0.46	0.20	0.18/ 0.22
Intervention Period*	Controlled Trials	0.16	77	0.14/ 0.17	0.67	12	0.63/ 0.70	0.48	0.45/ 0.51
	Pre- & Post Test	0.18	57	0.16/ 0.19	0.47	13	0.45/ 0.49	0.22	0.20/ 0.24
Sample Scope	6 months or less	0.10	27	0.06/ 0.13	0.25	6	0.18/ 0.32	0.29	0.23/ 0.35
	7 to 12 months	0.32	49	0.30/ 0.34	0.84	7	0.79/ 0.88	0.42	0.39/ 0.44
	more than 12 months	0.09	57	0.08/ 0.11	0.47	12	0.45/ 0.49	0.21	0.18/ 0.23
Health Maintenance Organization	Single Setting	0.18	87	0.17/ 0.19	0.51	17	0.49/ 0.53	0.30	0.29/ 0.32
	Multiple Settings	0.20	33	0.18/ 0.22	0.65	8	0.58/ 0.71	0.37	0.27/ 0.46
		0.11	14	0.08/ 0.13	NA	0.28	4	0.19/ 0.36	
<i>Intervention Characteristics</i>									
Number of Defined Interventions									
	1	0.19	73	0.17/ 0.21	0.68	11	0.64/ 0.71	0.42	0.40/ 0.44
	2	0.19	40	0.17/ 0.20	0.44	7	0.42/ 0.46	0.14	0.12/ 0.17
Target of Interventions	3 or more	0.11	21	0.09/ 0.12	0.87	7	0.79/ 0.94	0.52	0.41/ 0.63
Place of Interventions	Provider-focused	0.20	37	0.18/ 0.22	0.38	6	0.33/ 0.43	0.43	0.40/ 0.46
	Patient-focused	0.33	58	0.31/ 0.35	0.95	5	0.90/ 1.00	0.42	0.39/ 0.45
	Nurse or Staff-focused	NA	1		NA	1		0.11	0.08/ 0.14
Two targets or more		0.08	38	0.06/ 0.09	0.48	13	0.46/ 0.50	NA	0
During visit		0.42	58	0.40/ 0.44	0.43	4	0.37/ 0.49	0.42	0.39/ 0.45
	Outside visit	0.10	39	0.08/ 0.12	0.66	9	0.62/ 0.70	0.40	0.37/ 0.43
	Combination	0.07	37	0.06/ 0.09	0.50	12	0.47/ 0.52	0.07	0.05/ 0.10

NA: not applicable; only the number of cases involved two or more studies can be calculated the MWES. \*:one missing.

Table 3. Mean weighted effect sizes by intervention for studies of clinical preventive services

Type of Interventions	Authors, Year	No. of Cases	MWES	95% CI of MWES
Audit with feedback	Cardozo et al., 1998	6	0.59	0.50/ 0.68
Computer reminder	Holmboe et al., 1998	45	0.29	0.27/ 0.30
	Ornstein et al., 1991			
	Chambers et al., 1991			
	McDonald et al., 1992			
	Harris et al., 1990			
	Rosser et al., 1991			
	Burack et al., 1994			
	Tape et al., 1993			
	Landis et al., 1992			
	Pritchard et al., 1995			
	Litzelman et al., 1993			
Education (including patient or provider or both)	Herman et al., 1995	20	0.19	0.15/ 0.24
	Carney et al., 1992			
	Kikano et al., 1997			
	Bird et al., 1998			
	Goldberg et al., 1994			
	Herman et al., 1994			
	Lazarus et al., 1993			
	Jacobson et al., 1999			
Manual reminder	Duncan et al., 1991	26	0.31	0.28/ 0.34
	Kohastsu et al., 1994			
	Grady et al., 1997			
	Fiore et al., 1995			
	Chang et al., 1995			
	Hueston et al., 1994			
	Harris et al., 1990			
	Yarnall et al., 1993			
	Cowan et al., 1992			
	Landis et al., 1992			
	Pritchard et al., 1995			
Patient-held health diary or mini-recorder	Schapira et al., 1992	7	0.27	0.19/ 0.36
	Turner et al., 1990	4	0.12	0.08/ 0.16
Follow-up call + education	Kottke et al., 1992			
	Myers et al., 1990	25	0.27	0.26/ 0.28
	Tilley et al., 1999			
Computer reminder + education	Ornstein et al., 1995			
	McPhee et al., 1991	7	0.39	0.31/ 0.46
	Chodroff et al., 1990			
Education + flowsheet	Herman et al., 1995			
	Herman et al., 1994	8	0.06	-0.02/ 0.15
	Ammerman et al., 1999			
Manual reminder + patient-held health diary or mini-record	Dickey et al., 1992	32	0.15	0.13/ 0.17
	Struewing et al., 1991			
Tri-component or interventions (e.g., education +flowsheet + manual reminder +patient-held health guide...etc)	Leshan, et al., 1997	32	0.15	0.13/ 0.17
	Dietrich et al., 1994			
	Gottlieb et al., 1999			
	Kinsinger et al., 1998			
	Dietrich et al., 1998			

Note: Only the types of intervention involved two or more studies were presented in Table 3. The interventions involved one case (n=7) was not reported.



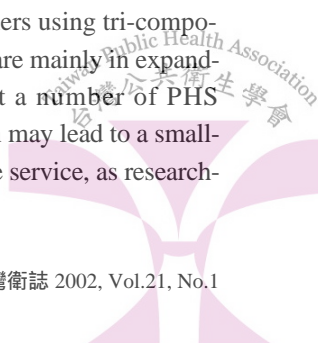
ing tests, lifestyle counseling and adult immunizations. Our results regarding screening tests are consistent with prior findings[28]. Papanicolaou's test and cholesterol screening rates are more resistant to change. In contrast, physicians deliver smoking counseling at a high rate. The relatively low delivery rate (though significantly increased with intervention) of sigmoidoscopy may be due to controversy related to its cost-effectiveness[94]. Providers should inform patients of the potential benefits and risks of sigmoidoscopy and enable the patient to make an informed decision[95,96]. The MWES were highest for lifestyle counseling among the selected PHS. It may suggest that patients' acceptance of office system tools and educational interventions to promote counseling activities is excellent, especially for patient-focused intervention if we ignore the other potential influential factors as mentioned in introduction session.

Widespread improvement in PHS delivery would improve the quality of health care[97]. Although the factors related to PHS delivery vary substantially among different primary care practices and unmeasured variables may determine the differential amount of improvement [24-26]. Increase in PHS delivery could cause substantial reductions in total mortality and morbidity[37,98]. The many office system tools and educational materials to increase use of PHS offer a wide selection of options that are effective and easily applicable in most primary care practices (e.g., flowsheet use, computer reminder, patient-held mini record or health diary, manual reminder, follow-up call and educational materials). PHS delivery rates were improved most when patients were the intervention target, with the exception of adult immunization. For counseling and adult immunization, when multiple interventions were used.

Some salient phenomena regarding study and intervention characteristics deserve attention. The 1990s saw a growing number of studies that

evaluated the effectiveness of office system and provider or patient education interventions to increase the delivery rate of PHS. Chart audit methodology was more common than that of patient or provider self-report. The majority of studies focused on screening tests and adult immunizations, ignoring lifestyle behaviors other than tobacco/ smoking counseling[57,61,82]. Counseling, in contrast to screening procedures and adult immunizations, has only recently received emphasis in the health care setting[68, 74]. Chart documentation of lifestyle counseling may underestimate its actual delivery as educational intervention is not routinely included in progress notes. However, the skills and processes involved are complex and difficult to perform [99] and thus, actual counseling rates might, in fact, below[68,77]. Although we did not take the other determinants into account, the finding that 7 to 12 months duration was optimal across PHS suggests the possibility that the intervention effects for PHS may not be sustained when the intervention period exceeds one year[51,100]. Future studies are needed to examine the institutionalization of interventions and their effects on rates of PHS over time.

Chart audit with feedback produced the best effect among all interventions, although this result may not be generalizable because of insufficient studies. Chart audit measurement directs attention to the quality of service delivery and, when audit and feedback is used, provides reinforcement to the clinician for service delivery [27,101]. An interesting finding was that combinations of three or more interventions did not produce the best effect for selected screening tests. However, this finding has also been reported in another meta-analysis[28]. The possible explanation is that researchers using tri-component or more interventions are mainly in expanding their efforts to affect a number of PHS simultaneously. This design may lead to a smaller effect for each preventive service, as research-



ers targeting a single service use fewer focused interventions that produce larger effects.

The most notable finding is that each intervention and combination of interventions showed positive effect sizes in the experimental (or post-test) direction, suggesting that the interventions are all valuable. We recognize that the context differs across primary care practices and may interact with the intervention used to produce different levels of success. One critical issue raised by our analysis is that other factors/barriers responsible for changing PHS delivery may also have confounded the findings. Although the office system and educational efforts examined here are designed to overcome patient, provider and health care system barriers that result in the less than optimal delivery of PHS, we understand that not all barriers can be eliminated by adopting office system and educational interventions. However, because researchers commonly have their personal interests in exploring the different determinants of PHS delivery, it is difficult to find a series of research papers that systematically address a number of determinants regarding PHS delivery except office system and educational interventions. Based on the situation, it is not feasible to involve the other determinants in a meta-analytic procedure even if they do impact the PHS delivery. In addition, researchers[102,103] have indicated that successful interventions aimed at physicians delivering PHS frequently use an office-system approach that targets not only physicians, but office staff and patients as well. There is also evidence showing that all PHS can be served by a single office system with many interrelated component processes. This approach may not only be efficient and effective, but also usable for all age groups[104].

Interested clinicians can adapt office system tools and educational materials to develop complete preventive protocols for their patients. However, there is evidence that suggests that the

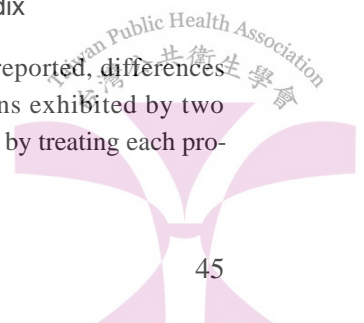
simple availability of a kit of materials is not sufficient to enhance the delivery of PHS as envisioned by clinicians or policy makers[105]. Additional strategies for dissemination and implementation of PHS will be required, such as providing external consultation services to practices, incorporation of PHS into health maintenance organizations, and training of residents in strategies for change in their future practices [105].

There are some limitations that could not be avoided in this study. First, there is vast heterogeneity found in the data. It is a trade-off to involve all available papers with limited randomized control studies instead of only including randomized control trials. At least all selected papers were published in peer-reviewed journals. In addition, similar findings were obtained after excluding all outliers, and the confidence interval remained in the positive range for each PHS. The second limitation is that our meta-analysis relied on published studies. However, all calculated tolerance levels exceeded the corresponding threshold tolerance, addressing that limitation. The third limitation is that interventions with few cases may not produce reliable estimates. More studies are required to address these issues.

The meta-analysis provides good evidence that, in research settings, delivery rates of PHS can be improved, often significantly, by certain interventions. The challenges for preventive medicine specialists in Taiwan are to apply these findings to actual practice by developing, implementing, and maintaining supportive systems and by overcoming barriers to the delivery of PHS.

## Appendix

1. When proportions are reported, differences between the proportions exhibited by two groups can be estimated by treating each pro-



portion as the mean of a distribution of 0's and 1's. Thus,

$$g = (P_E - P_C) / S_{\text{pooled}}$$

Where  $P_E$  and  $P_C$  are proportions for the experimental and control groups, respectively, and  $S_{\text{pooled}}$  is the pooled standard deviation of the samples of 0's and 1's, such that,

$$S_{\text{pooled}} = \{[(n_E - 1) \times s_E^2 + (n_C - 1) \times s_C^2] / [n_E + n_C - 2]\}^{1/2},$$

Where  $n_E$  and  $n_C$  are the number of observations for the experimental and control groups, and  $s_E^2$  and  $s_C^2$  are the variances for the experimental and control groups, respectively. The variance,  $s^2$ , for either of the groups is derived,

$$S^2 = p \times (1 - p),$$

where  $p$  is a group proportion.

Example:

There were 20 subjects in the experimental and control groups respectively. The baseline rates of receiving cholesterol screening are comparable. After conducting the office system intervention, the percentages of receiving this screening were 50% and 40% for experimental and control group respectively.

$$P_E = 0.5; P_C = 0.4; s_E^2 = 0.5 \times (1 - 0.5) = 0.25;$$

$$s_C^2 = 0.4 \times (1 - 0.4) = 0.24;$$

$$S_{\text{pooled}} = \{[(20 - 1) \times 0.25 + (20 - 1) \times 0.24] / [20 + 20 - 2]\}^{1/2} = 0.4950;$$

$$g = (0.5 - 0.4) / 0.4950 = 0.2020;$$

$$d = g \times c = 0.2020 \times [1 - (3/4 \times (20 + 20) - 9)] = 0.2020 \times 0.9801 = 0.1980$$

After we comprised 12 ds from reviewed cholesterol screening studies by using DSTAT, the composite effect size, MWES, was obtained as 0.10.

- Effect size  $d = g \times c$ , Constant  $c = 1 - (3/4 \times (\text{study } N) - 9)$ , study  $N = (N_E - 1) + (N_C - 1)$

A final adjustment of the calculated effect is often recommended to correct a tendency for overestimation of effect sizes, particularly where study  $n$ 's are small.

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