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行政院國家科學委員會補助專題研究計畫成果報告

調整品質後存活時間在醫藥衛生政策之應用（3/3）
Application of Quality Adjusted survival in Medicine and Health Policy Decision

計畫類別：☑個別型計畫　　□整合型計畫

計畫編號：NSC 89-2320-B-002-161- MH

執行期間：88 年 8 月 1 日至 89 年 7 月 31 日

計劃主持人: 王榮德

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職業醫學與工業衛生研究所

☑出席國際學術會議心得報告及發表之論文各一份

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一、中文摘要

由於社會經濟與醫療水準的提升，我們對「健康」的定義已不再僅關注於壽命的延長，對於生活品質的要求也日益殷切。因此世界衛生組織遂著手發展可做為跨文化比較研究的測量生活品質的工具，以作為醫藥療效評估、臨床及衛生決策分析等的參考。經過十年約 15 個國家 20 個中心的合作研究，發展了「世界衛生組織生活品質問卷(WHOQOL-100)」，總共 100 題可測各文化共通的一般性健康相關生活品質的題目，這些題目可被用來做為跨文化的比較；並允許各國依嚴格標準，將原始問卷翻譯為本國文字後使用；並可加入各文化特有的題目，用以測到屬於各文化特色之下的生活品質概念。由於考慮到臨床試驗或流行病學調查的實用性，該問卷再經進一步精簡成只有 26 題的簡明版問卷（WHOQOL-BREF）。我們先向世界衛生組織取得授權，並獲得國科會在研究經費上的支持，依照 WHOQOL 研究總部的規定，而發展了「台灣版世界衛生組織生活品質問卷」(完整版及簡明版)，簡明版除了 WHOQOL-BREF 的 26 個題目外，還加上了「飲食」及「面子」等兩個本土性層面的題目；我們也出版了完整版及簡明版的使用手冊供各界參考使用；並發展台語版問卷以利年長者施測。

此外，我們把生活品質整合入存活函數中以發展調整品質後存活人年（Quality adjusted life year，簡寫 QALY），作為醫藥衛生服務效用計量基礎之成本效性分析(cost-effectiveness assessment)基本方法；再合併成本計量，以評估並提高預防、診斷與治療及復健等各種醫藥衛生服務之效性。此種以 QALY 作共同單位來計量調整品質後存活時間（Quality adjusted survival，QAS）之方法，於 1996 年由黃景祥等本國學者提出：其估計方法是對一個世代之特定疾病者作長期存活分析；然後對這群病人作斷層性調查其現在之健康相關生活品質（Health related quality of life，HRQL）；再把 HRQL 乘入存活函數中加以積分即得該疾病病人之 QAS。此法已在泰國乳癌病人及台北市頭傷病人的實際驗證上證實其可行。並且黃景祥等又針對未能長期追蹤之病人發展方法從正常人之 QAS 借用部分資料進行延續估計(extrapolation)至終生；例如大部份之慢性疾病如果只追蹤了 5～7 年，則 80～90%以上病人尚存活中，在估計其存活函數上原有困難;但新法可解決此困境，而能對大部分疾病均可估計其品質調整後預期壽命

(Quality adjusted life expectancy，QALE)，以作成本效性評估之基礎。

我們已整合研究團隊，涵蓋了不同領域之專家學者，將繼續分四方面來進行成本效性研究：預防醫學與公共衛生、臨床醫學、復健醫學及另類醫學。以致力於發展出不同疾病之生活品質問卷，做為各疾病健康全貌（health profile）之評估基礎。再整合實質估計疾病的損失（cost of illness），以及願付價值法（willingness-to-pay）以對各種疾病作 cost-effectiveness 及 cost/benefit 分析。

關鍵字：WHOQOL，生活品質，健康相關生活品質，調整品質後存活人年、調整品質後存活時間、成本效性分析。

二、Abstract

To evaluate health care service and to facilitate internationally comparative studies on quality of life (QOL), the World Health Organization (WHO) have initiated a cross-cultural project on developing the WHOQOL questionnaire for generic uses. Through a scientific and systematic way, they have developed a questionnaire called the WHOQOL-100. It contains 100（culturally comparable）generic core questions and can be used for cross-cultural comparisons. It also allows each culture to add national questions for more precise characterization of the QOL in that culture. Later, considering the practical use in clinical and epidemiological survey, the WHOQOL-100 was further simplified as to contain only 26 questions, the WHOQOL-BREF. Through obtaining the authorization from the WHOQOL group, we have developed the Taiwan version of WHOQOL, both long and short form versions, which measure the health profile of a person with 24 facets: one question for each of the WHOQOL's 24 facets, one for overall health, one for overall quality of life and 2 questions specific for Taiwanese cultures (eating, and being respected or accepted). Also, we are currently developing the Taiwanese-dialect version questionnaires for interviewing senior person.

We have successfully integrated the QOL with survival function to become a common unit, QALY (quality adjusted life year), for assessing the cost-effectiveness of health care. It can further combine with the measurement of cost , thus can be an good evaluation method on preventive, diagnostic and therapeutic, rehabilitative and alternative medicines. Hwang et al developed the QAS (quality adjusted survival) method in 1996. It can estimate the total cumulative surviving utility for a population by conducting a cross sectional survey among people with HRQL (health related quality of life) questionnaire and multiplying the value with survival function . The estimation method was empirically tested in two studies. One study demonstrated that the utility loss for a case of head injury was 4.8 QALY. Another study calculated the QAS for 4 different stages of breast cancer patients in Chiangmai, Thailand. In 1998, Hwang and Wang further developed method to extrapolate the QAS curve for any cohort with more than 80-90 censored rate and was followed for a short period, say, 5 years. The break through has

made the estimation of QALE (quality adjusted life expectancy) for most chronic diseases possible. We have invited experts from various fields to organize a research team, which will further develop methods and conduct empirical studies for cost-effectiveness analysis on health and medicine.

Keywords: WHOQOL, Quality of life, QOL, quality adjusted life year, quality adjusted survival.

三、計畫緣由與目的

傳統上有關醫療衛生及人民健康等之統計，均以死亡率、罹病率來作為衡量比較之依據，因此壽命之長短乃成為評價生命最基本之單位，對於個人之健康也以「生病否」作為判斷之憑據。因此國家整體醫療衛生政策之制訂、施政之思考角度、相關之學術研究及實務應用之成效等也以死亡、罹病為判定結果之主要依據。隨著社會的發展、經濟及醫療水準的提升，人們亦日益注重身體的健康，然而健康之定義並非僅延長壽命或減少罹病，對生活品質也應加以重視，因此除了傳統之健康指標（譬如死亡率、罹病率、平均預期壽命等）之外，歐美先進國家也以健康相關生活品質（Quality of Life, QOL）作為指標，並廣泛應用於療效評估、健康風險分析、流行病學研究等領域。

生活品質之測量主要以問卷為之，目前有數種版本的生活品質問卷被普遍的使用，如：Sickness Impact Profile, Nottingham Health Profile, MOS SF-36 等，然而它們並未完全針對生活品質的概念來設計，而只是測量疾病或失能所造成的衝擊；此外，這些問卷之設計，多以歐美文化體系為基礎，若要將其使用於另一文化，在翻譯方面及文化適用性都是一大挑戰；又目前健康照顧方面也越來越重視「人」而非疾病本身，亦即是重視全人的照顧（holistic approach），有鑑於以上這些原因，世界衛生組織（World Health Organization, WHO）遂著手發展一份由多個地區、多種背景的人參與合作，並可做跨文化比較研究之測量生活品質的工具，以作為研究、醫藥療效分析、臨床及衛生決策分析、擬定及評估等的參考。因此於 1991 年開始，經數年針對此研究議題進行一連串的研究、開會、討論，最後經過綜合彙整之後，發表了研究 QOL 的成果，即一份健康相關生活品質問卷，定名為「世界衛生組織生活品質問卷（WHOQOL-100）」，其內含有 100 題測各文化共通的一般性健康相關生活品質的題目，稱之為一般性題目（generic items），這些題目可被用來做為跨文化的比較。WHOQOL 問卷並允許各國依照所訂定出來的嚴格標準，將 WHOQOL-100 原始問卷翻譯為本國文字後，並加入各文化特有的題目，稱之為國家性題目（national items，在台灣我們慣稱為本土性題目），這些題目能補足一般性題目無法測到屬於各文化特色的生活品質概念。

本計畫之目的乃引進 WHOQOL 並發展出適合我們自己的生活品質問卷，以供本國醫藥衛生界應用，並將生活品質與存活函數及成本效性之經濟概念相結合，以發展成醫藥衛生政策之重要評估工具。有關本計畫所完成之事項簡述於後。

台灣版世界衛生組織生活品質問卷的發展

發展過程

經向 WHOQOL 瑞士日內瓦研究總部取得台灣版問卷的發展權後，著手進行生活品質各層面的定義及問卷題目的翻譯工作。先後參與的人來自各種背景，包括：各科專科醫生、護理師、藥學專家、物理治療師、職能治療師、健康行為專家、健康人類學家、心理計量學家、流行病學家、生物統計專家、公共衛生學者等專家、教授們。根據 WHOQOL 研究總部的規定，對生活品質各層面及問卷中的各題目進行逐字逐句反覆地的討論，期望在文字、概念及語意的翻譯上能達到適當性、對等性（equivalence）及符合本土文化的標準，翻譯後的文件先後除了讓一般人閱讀外，最後並由兩位雙語外籍人士（bilingual translators）進行回翻英文的步驟（back translation），並再進行討論及修改，以確定最後台灣版本的世界衛生組織生活品質問卷。

問卷量尺的發展

原 WHOQOL-100 問卷中所採用的量尺共分為四大類型，包括：能力（capacity）類型、頻率（frequency）類型、強度（intensity）類型，以及評估（evaluation）類型，每類型量尺皆是採用李克氏（Likert's）五點量尺的形式。為了要選擇符合本土性且克服過去所採用的不等距（un-equidistance）量尺標示語詞的缺點，WHOQOL 研究總部鼓勵各國對自己文化所使用的量尺語詞從事研究。我們也進行了本土量尺標示語詞的研究，找出了四大類型本土性的量尺標示語詞，作為台灣版問卷使用的量尺語詞，關於這方面的研究我們發表了兩篇論文[附註１，２]。

本土性題目的設計

問卷除了一百題各文化共通的題目外，還可另外加入符合本國文化特性的本土性題目，我們依照 WHOQOL 研究總部建議的方法，進行數次對專家、不同疾病及病情程度的病人與其家屬的焦點團體（focus groups）進行討論，以便作為編製本土性生活品質問卷題目的參考。最後決定於台灣版問卷中初步加入 20 題本土性的題目，其中包括了 11 題屬於兩個新增加的本土性層面：「被尊重及接受（面子與關係）」與「飲食」。這些新編製出的題目還需經過實地收集受訪者資料的測試，依各題目心理計量特性的好壞，來篩選出最好的本土性題目。

台灣版問卷的預試

接下來我們對這 120 題的台灣版問卷做測試，除了要瞭解原 WHOQOL 問卷的 100 題核心題目的心理計量特性外，還要從外加的 20 題題目中篩選出最適當的本土性題目。我們對全台灣東西南北共十六家區域級以上的醫院及一家大型診所進行訪視，針對不同疾病的門診及住院病人以及健康人（如病人家屬、醫院員工、志工）收集資料，共收集到 1068 份有效問卷。且經過修改後，又翻譯回英文，可供不懂華語文字之受訪者使用。可是台語之問卷量尺尚未實際研究，此為美中不足之處，未來應該像華語版一樣有嚴格之測試。

台灣版問卷的分析結果

我們對所收集到的問卷資料進行描述

統計分析、信度（包括內部一致性、再測信度）及效度（包括內容效度、區辨效度、效標關連效度、預測效度、建構效度）的研究，發現台灣版問卷具有良好的信度及效度，並且結果也與世界其他各國的結果相近。

關於本土性題目的測試及篩選，依照 WHOQOL 研究總部的規定，這些被測試的本土性題目的心理計量特質，需要與全球性及本土版問卷中的核心題目的資料來做比較，以決定是否該被選取入正式的問卷中。我們使用了十多種計量方法，最後由 20 題原設計的本土性題目中篩選出 12 題作為台灣版問卷的本土性題目，其中包括了新增加的兩個本土性層面各四題，因此台灣版世界衛生組織生活品質問卷包括了 100 題全球共通性題目及 12 題本土性題目，一共是 112 題。新增加的兩個層面「被尊重及接受（面子與關係）」以及「飲食」，在經由計量分析後可分別被歸為「社會關係」及「環境」範疇。

我們將這部分的研究出版了一本「台灣版世界衛生組織生活品質問卷之發展及使用手冊」供使用該台灣版問卷者參考[附註 3]；同時也發表了一篇論文〔附註 4〕。

台灣簡明版問卷的發展

依照 WHOQOL 研究總部的規定，台灣簡明版問卷除了採用全球共通的 WHOQOL-BREF 的 26 個題目外，還可加上所選出的本土性題目。我們自新增加的兩個本土性層面中各挑選出一個題目，因此台灣簡明版問卷乃是由 28 個題目所組成。於這兩個新的層面中篩選題目的標準，是採用世界衛生組織發展簡明版問卷相同的計量分析方法，使用的資料來源仍是於發展台灣版世界衛生組織生活品質問卷時所收集到的 1068 份有效問卷。我們將這部分的研究也出版了一本「台灣簡明版世界衛生組織生活品質問卷之發展及使用手冊」供使用該台灣版問卷者參考[附註 5]。

台語版問卷之發展

WHOQOL 問卷以自填為主，對於不識字或年紀大視力不佳之受訪者，我們特別發展了台語口頭施測之簡明版問卷。此問卷已經「社區老人跌倒之預防的研究計畫」於高雄縣湖內鄉進行施測。

成本效性方法之發展與應用

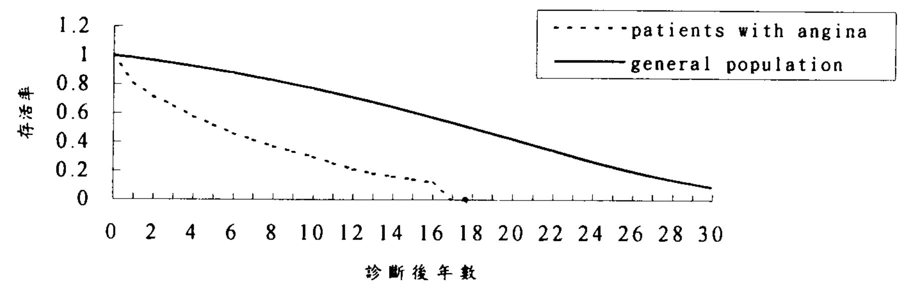
有關成本效性方法之發展與應用我們已發表了一篇論文〔附註 6〕，其基本概念簡述如後。早期計量 QALYs 之方法，基本上假定某種疾病造成之健康狀態將持續到預期壽命，例如迦納健康評估計畫團所提出者。此法一般對急性疾病之評估可以準確到某個程度，但是對於慢性會致命之疾病，如癌症、中風、冠狀動脈心臟病等等，由於健康狀態呈不斷的動態變化甚至死亡；上述假設根本不成立。後來以 Glasziou 為主的統計學家亦提出以模式建構法對各種健康狀態之持續期作預估，此法對癌症類疾病可能可以準確到某個程度，因為癌症病人病情變化狀況比較可以大致分成數類，但對其他大部分之嚴重疾病如糖尿病、中風、脊髓損傷等在不同時間卻各有許多不同狀況，如此作會十分複雜。本國學者黃景祥等共同提出一個較簡單的解法：即是把 HRQL 直接乘入存活函數中，此即為生活品質調整後存活時間（QAS，quality adjusted survival）計量，將其取積分至無限大，即可得 QALE（quality adjusted life expectancy），而 HRQL 可從目前尚存活而存活期不同的病人作橫斷面的隨機抽樣調查取得。計算 QAS 之作法如下：

(1)先用 QAS 測量法進行健康效用之計量，此計量法必須取得某病(x_i)病人存

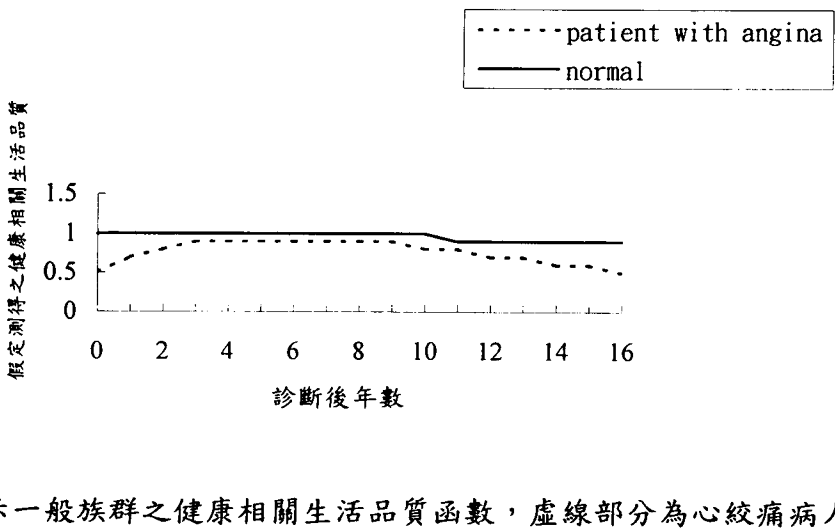
活函數(survival function, 以 $S(t|x_i)$表示)，見圖一；實線部分表示 1950-60 年代美國一般族群之存活曲線，虛線部分表示同時期美國心絞痛病人得病後之存活曲線。不同罹病期之健康相關生活品質(HRQL)函數(以 $q(t|x_i)$表示，此圖之數值為假設可以測出者)，見圖二；實線部分表示一般族群之健康相關生活品質，虛線部分表示心絞痛病人得病後之健康相關生活品質。存活函數與生活品質在各個時間 t 相乘得一曲線再積分得到 QALY 作單位之 QAS，見圖三，實線與虛線之間之區域即為一般族群與心絞痛病人在品質調整後存活人年之差異。某病之生活品質調整後之預期壽命（Quality adjusted life expectancy）數學式如下:

$$E(QAS|x_i)=\int_0^\infty E(q(t|x_i))S(t|x_i)dt$$

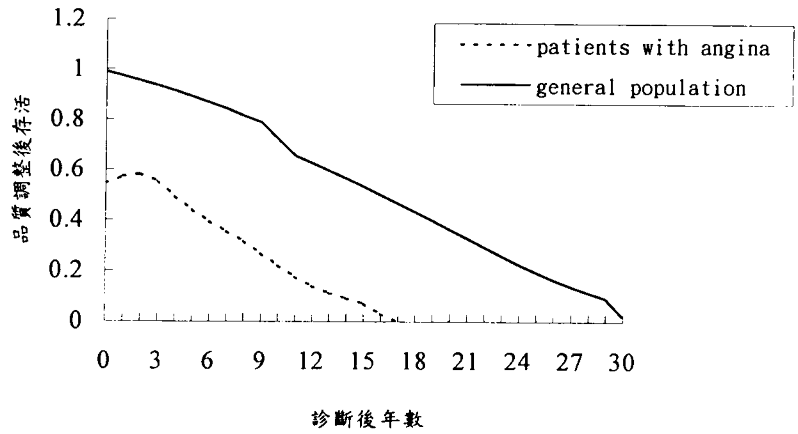
若正常人之此二函數為 $q(t|x_0)$及 $S(t|x_0)$則得某病 QAS 之終生損失為:$E(QAS|x_i)-E(QAS|x_0)$（圖三兩曲線下面積之差）



圖一 實線部分表示一般族群之存活曲線，虛線部分表示心絞痛病人在平均得病年齡 59 歲後之存活曲線。



圖二 實線部分表示一般族群之健康相關生活品質函數，虛線部分為心絞痛病人之健康相關生活品質函數。一般群族在診斷 10 年後的一段下降是假設在 70 歲後的健康相關生活品質由 1 下降至 0.9。



圖三 虛線部分表示一般族群之品質調整後存活曲線，虛線部分為心絞痛病人得病後之品質調整後存活曲線，兩曲線下之面積各為其 QALE，而中間的區域面積即為心絞痛病人在得病後品質調整後存活時間的損失。

(2)同理，假定得 x_I 病之病人之工作能力為 $W_a(t|x_i)$，則得此病後之終生剩餘工作能力為

$$\int_0^\infty E(Wa(t|x_i))S(t|x_i)dt$$

而得某病之工作能力間接終生損失為

$$\int_0^\infty E(Wa(t|x_0))S(t|x_0)dt-\int_0^\infty E(Wa(t|x_i))S(t|x_i)dt$$

(3)假定我們可經由仔細問卷取得疾病造成直接增加之經濟損失隨時間之函數為 $C(t|x_i)$，其中假定在 $C(t|x_i)$函數內在適當條件下必須有折現公式將貨幣價值齊一化。

$$\int_0^\infty E(C(t|x_i))S(t|x_i)dt$$

則某病 x_I 之人力資本法總損失為

$$\int_0^\infty E(C(t|x_i))S(t|x_i)dt-\int_0^\infty E(C(t|x_0))S(t|x_0)dt+\int_0^\infty E(Wa(t|x_i))S(t|x_i)dt-\int_0^\infty E(Wa(t|x_0))S(t|x_0)dt$$

(4)以上之方法以可被歸納成一條較通用之公式，計量罹患各種病後尚存之各種效用 $U(t|x_i)$:

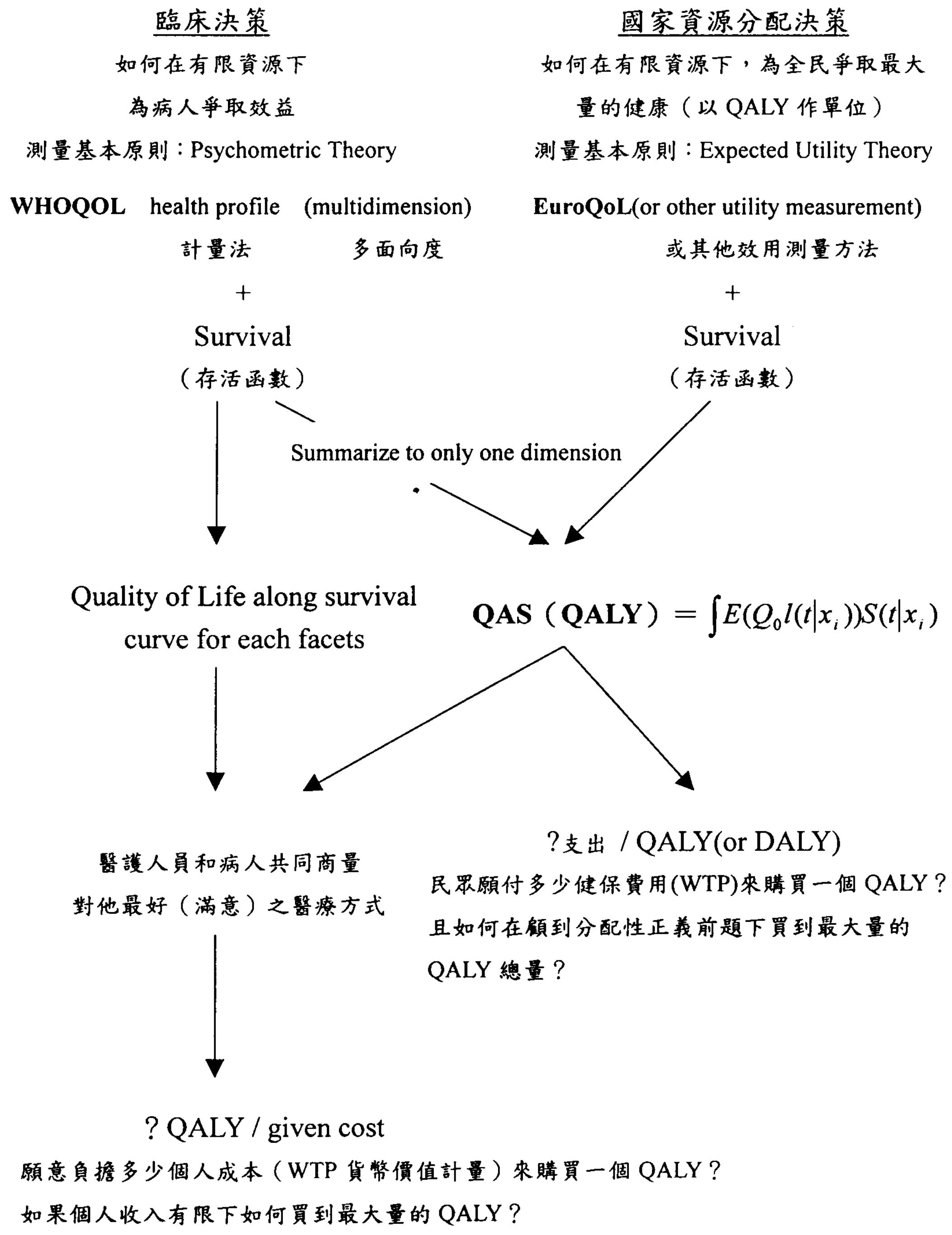
$$E(u) = \int_0^\infty E(U(t|\ x_i))S(t|\ x_i)dt$$

其實經濟學者也有相類似之看法，再加上經濟上的折現公式其公式與上面公式相似。但是上列直接與間接經濟損失計量方法雖然信度良好，卻缺乏福利經濟學之理論基礎，且所量得之結果約是利用願付(WTP, willingness-to-pay)法所量得者之下限值。故經濟學者們亦發展假設市場評價法(CVM, contingent valuation method)來測量一般人及病人為避免某病的願付貨幣價值。

我們用上述方法於急性事故造成頭傷病人的健康效用損失估計上，已估計出平均每個頭傷病人終生損失 4.8 QALY，以及台北市一年認真執行安全帽法律可節省 6240 QALY 之損失。同時與泰國 Mahidol 大學合作追蹤 861 名乳癌患者 12 年發現第 1-4 期之乳癌患者 QAS 各為 118.0，92.4，62.5，28.2 QALM(Quality adjusted life month)。但是除了第四期患者之外，其它三期乳癌病人經 12 年追蹤均尚存活 30%以上；其中第一期乳癌在追蹤停止後尚有 90%存活率。由於最好要追蹤到一半以上的病人均過世，方能較準確計算存活函數；使得此法估計初期乳癌之 QALE 有困難。但是黃景祥與王榮德又發展出如何外插估計 QAS 之方法：主要作法是假定病人之 $QAS(t|\ x_i)$與同年齡同性別無此病之一般人 $QAS(t|\ x_0)$之比視為一個函數 W(t)，此值介於 0 與 1 間；如此再對 W(t) 取 logit 可得到一近乎線性之函數，再回推病人之 QAS（$t|\ x_i$），此法已由模擬研究證實其準確性與實用性；且已被著名醫學統計雜誌接受，同時也應用到泰國資料，推估出 1-4 期泰國乳癌之病人之 QALE 各為 245± 48，144± 16，109± 22，30± 6 QALM。以上初步的成果，使我們預測此方法有潛力被發展為評估醫藥衛生效用之基本方法，故希望在未來數年內進一步將此法應用到其他疾病及整個醫藥衛生領域。同時再整合各領域（包括成本計量），逐步邁向成本效性分析(cost-effectiveness analysis)甚至成本效益分析(cost-benefit analysis)。

醫療資源的分配，可分成國家整體決策與醫療人員對個人臨床決策二個層次來看。在臨床決策的層次下，目的在有限的資源下為病人爭取權益。其所使用的基本測量原理是 Psychometric Theory，主要利用多向度的 health profile 計量法（如 WHOQOL），較仔細測量病患的健康相關生活品質，經與存活函數結合後，一方面可摘要成一個整體的範疇分數以計算 QALY；另一方面也可以生活品質的每一個層次（facet）來看其在存活函數上的變化情形。另外，也必須基於 expected utility theory 來做生活品質之效用測量，使它變成只有 0-1 之間的數目;它與存活函數結合即是生活品質調整後之存活（QAS），作終生之積分即是生活品質調整後之平均餘命（QALE）。有了以上二種評量效性（effectiveness）的工具，就能提供參考，讓醫護人員和病人得以共同商量對病人最好（滿意）的醫療方式。經濟上用貨幣價值對健康效益之估計亦有 2 種方法，一種是疾病成本法（cost of illness）及願付價值法（willingness to pay，WTP），前者為

後者之低估值。WTP 較合福利經濟理論，目前用在疾病上之評估方法主要用 Contingent Valuation Method(CVM)。結合上述效益及效性之估計，即可進一步討論病人願付多少代價（貨幣價值計量）來買一個 QALY，及如何在個人收入有限的情況下，購買到最大量的 QALY。另外，在國家資源分配決策的層面下，目的在有限資源下，以 QALY 為單位，為全民爭取最大量的健康。亦即估計人民願付多少健保費用，來購買一個 QALY 及如何在顧到分配性正義的前題下購買到最大量 QALY 總量。詳見圖四。



圖四

中醫藥在華人居住之國家被廣泛使用早已有數千年之歷史，最近數年也開始引起歐美之重視，被列入在另類療法(alternative medicine)之中。可惜長久以來未能作適當之評估以去蕪存菁發揚光大；其主要困難至少有 2 點：一為藥效可能被其他變因所解釋，或說藥效之評估未能充分排除其他變因；其次為其效果主要在生活品質方面。而上述 2 者一直到最近 10 年才較有解決方法，未來上述方法亦可用來評估中醫藥及健康食品以促進其發展及世界市場之開拓。〔附註 7〕復健醫學原是為歲月增添生命，當全世界以及本國人口均已逐漸老化之時，此門學問之重要性在 21 世紀是必然之趨勢。可惜自健保實施以後，資源逐漸集中到診斷與治療；使得復健醫學對人體健康之貢獻似乎相對的逐漸被忽視。盼望能藉此研究對其療效作適當之評估，以免未來在健保給付排擠效應越來越厲害時，復健工作被不當的排除在給付之外或減少給付，如此將不利全民健康。此外，本國目前已在逐漸發展復健用科技輔具並希望打入世界市場，唯其效益之評估為推廣此科技產品之必要條件，本研究所發展之世界衛生組織健康相關生活品質 24 層面評估，最能顯出其功效。〔附註 8〕

研究團隊之整合

為了完成整合性之研究，已結合相關領域之專家組成研究團隊，成員涵蓋經濟、統計、心理計量、公共衛生，臨床醫學、復健醫學、另類醫學（包括中醫藥）等。實際上從民國 88 年 1 月起，每月一次由各領域之專家對研究團隊成員及研究生授課，此課程將持續進行，歷次演講目錄請見附錄一。

由於將來各相關研究中，有關問卷之設計與應用等均屬心理計量之領域，亟需此領域之專家的支援，因此團隊中之台大心理系姚開屏老師將以 WHOQOL 台灣版發展小組的代表人身份提供必要之支援與服務。

整合研究之架構

〔由於國科會所能支援之經費有限，故亦有向其他單位爭取經費者，全部列於此〕

預防醫學與公共衛生（第一醫學）	臨床診斷決策（第二醫學）	復健醫學（第三醫學）	中醫藥療效評估（另類療法）
1.特定疾病版生活品質問卷發展 姚開屏（心理系）	6.重大外傷治療 陳石池、林芳郁（急診醫學科）	13.脊髓損傷病人 王顏和、張彧（復健部）	17.慢性阻塞性肺部疾病 陳建仲（中國中醫內科） 梁文敏（中國公衛系）
2.壽命延長與健康品質提升效益估計 劉錦添（經濟系）	7.心肌梗塞病人 廖朝崧、蘇大成、簡國龍、李源德（內科心臟）	14.中風病人 羅鈞令（職治系） 胡名霞、湯佩芳（物治系）	18.更年期婦女中藥臨床評估 賴榮年（陽明中醫科） 王榮德（職衛所）
3. 環境與職業性危害之比較風險評估 王榮德、詹長權（職衛所） 郭壽雄（內科胸腔）	8.糖尿病慢性併發症 戴東原、吳惠培（內科新陳代謝） 陳慕師（眼科）	15.中老年髖骨骨折 曹昭懿（物治系） 楊榮森（骨科）	
4.機車事故引起之創傷性脊髓損傷 林茂榮（中國公衛）	9.腎臟移植護理衛生政策 施富金（護理）李伯皇（外科）	16.冠狀動脈繞道手術病人 吳英黛（物治系） 王水深（外科）	
5.社區老人跌倒之預防 蔡益堅（衛生署家庭計畫研究所）	10.腦血管疾病 鄭建興、葉炳強（神經科） 11.急性骨髓性血癌療法評估 唐季祿（內科）許駿（血液腫瘤） 12.愛滋病診治評估 陳茂源、方啟泰（內科免疫）		

網站之建立

為了提供最新的資訊並促進相關研究者之間學術上的溝通與切磋，我們建立了『生活品質／成本效性』網站，作為大家討論之平台，網址為 http://ha.mc.ntu.edu.tw/~cfyu/ 。目前網站之內容包含：研究團隊與研究主題之簡介、研究工具之簡介、相關網站之連結、網路論壇、相關研究最新的資訊等。網站之內容將不斷改進與充實，期能對國內相關研究者提供最好的服務。

相關研究經驗之累積與資料庫之建立

本計畫所發展之生活品質問卷已公開給國內各界免費使用，但各研究者須依照規定使用問卷，這些規定包括了：研究者不能任意更改問卷中的指導語、題目的字句、量尺形式、題目順序等，並且研究者在使用本問卷前，需通知本問卷發展小組，本小組有權負責監督本問卷在台灣的使用情形，以及提供各研究者必要的協助，如此得以維持好的研究品質，並建立統合之資料庫。如此相關研究經驗得以累積與傳承，同時避免重複相同之研究，將來相關研究之結果可集中送回給 WHOQOL 研究總部做全球性的生活品質研究。

總結

本計畫所發展之問卷及成本效性之研究方法均已公開提供給國內各界利用，目前正經由整合各不同領域之研究計畫做更廣泛且深入之研究，期使國內相關研究之水平，能有面的提升。團隊中之數個研究計畫將同時採用其他生活品質問卷，以作為比較，如此應可使我們的研究內容更臻完備；加上運用我們創新之成本效性評估方法，則整體學術研究之成果在國際上的相關領域應可佔有一席之地。更重要是發展出新的工具，可作為評估臨床療效、科技輔具之功效、制訂醫藥衛生決策等之基礎，同時啟動國內相關研究及其應用的契機。

附註：

本研究相關所發表之論文與出版刊物：

1. 林茂榮、姚開屏、黃景祥、王榮德：台灣版世界衛生組織生活品質問卷量尺語詞的選擇。中華衛誌，1999；18：262-70。
2. 姚開屏、林茂榮、王榮德：同質團體與異質團體在量尺語詞選擇的的比較研究。中華心理學刊，2000；41(2)：141-153。
3. 台灣版世界衛生組織生活品質問卷發展小組：台灣版世界衛生組織生活品質問卷之發展及使用手冊。第一版，台北：台灣版世界衛生組織生活品質問卷發展小組，1999。
4. 台灣版世界衛生組織生活品質問卷發展小組：台灣版世界衛生組織生活品質問卷之發展簡介。中華衛誌，2000；19（印行中）
5. 台灣版世界衛生組織生活品質問卷發展小組：台灣簡明版世界衛生組織生活品質問卷之發展及使用手冊。第一版，台北：台灣版世界衛生組織生活品質問卷發展小組，2000。
6. 王榮德、游正芬、鍾智文、姚開屏：二十一世紀之健康照護效性評量--生活品質與生活品質調整後之存活分析。台灣醫學，2000；4(1)：65-

74。
7. 王榮德、林淑文：另類醫療療效評估之困難及可能解決之道。（投稿中）
8. 張 彧、王顏和、游正芬、鍾智文、王榮德：以焦點團體方式探討影響脊髓損傷患者生活品質之因素。中華復健醫誌，2000；28(2)：87-95。（經費主要部分由臺大醫院支助）

附錄一：研究團隊歷次演講目錄

<table>
<tr><th>編號(月份)</th><th>講者</th><th colspan="2">講　　題</th></tr>
<tr><td>1</td><td>王榮德</td><td colspan="2">如何寫作者欄和致謝欄</td></tr>
<tr><td>2</td><td>姚開屏</td><td colspan="2">Taiwan Version World Health Organization Quality of Life Measure</td></tr>
<tr><td>3</td><td>王榮德</td><td colspan="2">Quality Adjusted Survival</td></tr>
<tr><td>4</td><td>姚開屏</td><td colspan="2">心理測驗編制標準化過程</td></tr>
<tr><td>5</td><td>施富金</td><td colspan="2">Focus Group & Qualitative Studies</td></tr>
<tr><td>6</td><td>楊銘欽</td><td colspan="2">衛生計畫之經濟評估（成本效益分析）</td></tr>
<tr><td>7</td><td>劉錦添</td><td colspan="2">Valuing Health for Policy</td></tr>
<tr><td rowspan="3">8(88.08)</td><td>陳恆德</td><td colspan="2">臨床試驗-相關法規及審查體系</td></tr>
<tr><td>陳紹琛</td><td colspan="2">Randomized Control of Regulatory Quality</td></tr>
<tr><td>王　玫</td><td colspan="2">General Statistical Issues in Clinical Trials</td></tr>
<tr><td>9(88.09)</td><td>楊銘欽</td><td colspan="2">慢性疾病罹病成本之估計及實例</td></tr>
<tr><td>10(88.10)</td><td>姚開屏</td><td colspan="2">台灣版 WHOQOL 介紹</td></tr>
<tr><td>11(88.11)</td><td>劉錦添</td><td colspan="2">『”Willingness to Pay” method in health service』</td></tr>
<tr><td rowspan="2">12(89.01)</td><td>謝清麟</td><td colspan="2">『Utility measurement in health and medicine: EuroQol as an example』</td></tr>
<tr><td>胡賦強</td><td colspan="2">Exploratory Factor Analysis(EFA) versus Confirmatory Factor Analysis(CFA)</td></tr>
<tr><td>13(89.04)</td><td>王榮德</td><td colspan="2">standard gamble method 討論
台語版問卷定稿</td></tr>
<tr><td>14(89.05)</td><td>張　彧
李昕怡
張郁瑩</td><td>疾病別生活品質問卷發展之實際範例與示範</td><td>脊髓損傷
老人髖骨骨折
COPD</td></tr>
<tr><td>15(89.06)</td><td>熊秉荃
王榮德</td><td colspan="2">疾病別生活品質問卷發展之實際範例與示範二：愛滋病研究
另類醫療療效評估之困難與解決之道，更年期研究介紹</td></tr>
<tr><td rowspan="2">1(89.07)</td><td rowspan="2">張　彧
梁文敏
王榮德</td><td>已進行疾病別生活品質問卷發展的研究團體作進度報告</td><td>脊髓損傷病人研究
慢性阻塞性肺部疾病研究</td></tr>
<tr><td colspan="2">討論 survival adjusted psychometric value 之含意</td></tr>
</table>

參加國外學術研討會之心得

計劃編號：NSC 89-2320-B002-161-M56

〔一〕International Epidemiological Association 〔IEA〕

時間：Aug 31-Sep 4

地點：Florence, Italy

與會人士：共 77 國，1051 人參加

報告內容：Quality Adjusted Survival 〔QAS〕method presentation 〔附件一〕

心得：

1.本人過去都是參加職業衛生學會的會議，此次到 IEA 報告得到好評，發表以計算 QALY 的方式實際計量 Effectiveness。並告知各國學者本人有一本「流行病學方法論」在世界衛生組織〔WHO〕的網站http://www.who.int/peh-super/Wang/Wang's%20content.html 刊載，並直接下載給有興趣的亞洲學者參考。

2.會中開會選舉下屆理事長〔President〕，由泰國 Chulalongkong 大學公共衛生學院院長當選，是此學會第一次由發展中國家來當選理事長，對我們是一大鼓舞。

〔二〕International Society of Environmental Epidemiology〔ISEE〕

時間：Sep 5-Sep 8

地點：Greece, Athens 雅典

與會人士：共約 30 國，500 人參加

報告內容：台灣空氣污染對小孩之影響〔附件二〕

心得：

1.在舉辦期間遭逢當地發生 Richter Scale 5 級地震，造成停電，幸好主辦單位應變得宜，對大會之進行並未造成嚴重影響。

2.途中有到聖經「使徒行傳」第 17 章中所提之亞略巴古講演高台，看哥林多地峽，到該地之最主要原因在於聖經爲流傳久遠，全世界都知曉的典籍，讓人感觸以後發表的論文數量不必多，但要能有長久之貢獻較好，期許在品質上繼續努力下工夫，勝過追求數量眾多！

主持人：台大公衛學院職衛所　王榮德　2000.11.23

P17.14 -

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ESTIMATION OF UTILITY GAINED FROM EARLY DIAGNOSIS OF BREAST CANCER BY QUALITY ADJUSTED SURVIVAL: Breast cancer of northern Thailand as an illustration

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Abstract

The objective of this study was to determine the utility gained from of early diagnosis in terms of quality adjusted life month (QALM) by estimating the quality adjusted survival (QAS) for different stages of breast cancer. A cohort of 779 cases of breast cancer from Chiangmai, Thailand were followed for 12 years. Each case was classified according to the international classification of tumor staging at the first diagnosis. A cross-sectional, stratified, random sampling were conducted, and 233 cases were selected and interviewed with WHOQOL (World Health Organization quality of life) questionnaire and EuroQol (European quality of life) standard gambling method to obtain health profile and utility of health, respectively. Estimation of QALE (quality adjusted life expectancy) for 4 different stages was calculated by a kernel-type smooth estimator for QAS and a Monte-Carlo simulation for extrapolation to life time of censored data using age-sex-matched reference group from the general population. The result showed that the QALEs for stages I--IV of breast cancer were 245± 44, 144± 19, 107± 22 and 30± 6 QALMs, accordingly. After adjusting age of onset, the utility gained from early diagnosis which detect the cancer one stage earlier were 135, 81, 5, and 60 QALMs, accordingly. We concluded that preventive measures which lead to early diagnosis of breast cancer at stage I may be the most effective way of health services.

INTRODUCTION

Long term follow up studies on breast cancer patients have been conducted for several decades (1-3). Data on survival for different stages of breast cancer have also been documented (2). As breast cancer patients suffered from not only a shorter survival period but also a lower HRQL (health related quality of life), there were studies conducted on the health profile of their HRQL (). The task is particular difficult for patients with long term survival, because the tool for measuring utility and/or health profile of HRQL was developed recently and it usually required chronic, repeated assessments. Thus, although several studies directly or indirectly dealt with the utility (or simply survival) gained from early diagnosis of breast cancer (), there has been no study, to our knowledge, examining the issue under a combination of HRQL and survival for different clinical stages.

HRQL and QALY (quality adjusted life year), as measures of outcome evaluation in health context, have been increasingly used in the analysis of health-related studies, especially cost-effectiveness analysis, in recent years (6-8). The HRQL is often measured by utility scale or health profile and then summarized to reference points between 0 and 1; perfect health is assigned a weight of 1 and a state equivalent to being dead a weight of 0 (8). An individual's QAS (quality adjusted survival) is given as the integration of the patient's utility through his/her survival duration, and the expected QAS for a population with a specific disease was also proposed by Hwang et al to be area under the QAS curve (9). The method was further developed so that the QAS curve can be extrapolated to a full life span (10). Although the Monte-Carlo method was first used on the estimation of life long utility loss from head injury, it was used as a special case of assuming the same survival function as the general population after 7 years of follow up (11). The proposed more general approach (10) has never been applied on empirical studies. Thus, the objective of this study was to estimate the life-long QAS of breast cancer in 4 stages and the utility obtained from diagnosing it one stage earlier. The cancer registry from Chiangmai of Thailand provided us an opportunity to test the feasibility.

SUBJECTS AND METHODS

Breast cancer cohort from Chiangmai cancer registry

A cohort of 781 cases of breast cancer who were first diagnosed during 1985-1994 were followed up regularly at Chiangmai cancer registry for 12 years. The Chiangmai cancer registry is a population-based registry, co-sponsored by the Chiangmai University Faculty of Medicine and WHO (World Health Organization), which actively collects data on cancer patients from 1 university hospitals, 10 private hospitals, and 26 public hospitals with a total of 4,326 beds in Chiangmai province, Thailand (12). Following data were obtained and edited into computer files for each case: name, address, gender, hospital, dates of birth and first diagnosis, methods of diagnosis, clinical staging, histological types, primary site of cancer, type of treatment, data of death and cause of death. In addition to the regular follow-up at out patient clinics, the registry center sent out mails and telephone calls annually to determine the survival states and matched with the death certificates provided by the Chiangmai Public Health Service to double check the validity of the data. Moreover, one of our co-authors carefully verified each patient's data through calling and/or visiting the next of kin of the patients who were lost to follow up. Finally, a total of 781 cases were enrolled as the cohort of this study.

Selection of sample for measurements of utility and quality of life

On the data of censored point which was June 30, 1997, we found that 433 patients (56.7%) were still alive. We stratified the cohort into 4 different clinical stages and performed random sampling to choose 50 patients for each stage (9). In addition, we intended to draw 15 patients for each stage who were diagnosed during 1995-1997 to fill up the gap of less than 2 years of duration-to-date. However, since only 28 surviving cases of stage IV can be interviewed, they were all included. There were 14, 22, and 19 newly diagnosed consecutive cases for stage I through III, expected utility theory, i.e., standard gamble method to quantify patient's subjective preference. The patient was asked to consider a hypothetical choice between the certainty of continued life in the current health state and a gamble. The gamble had two outcomes: either full health (assigned a utility of 1), or death (assigned a utility of 0). The probabilities in the gamble were incrementally changed until the subject was indifferent to the choices of continued life in her current health state and the gamble. The expected value of the gamble at this point was, by substitution, the utility for the current health state. A chance board and a probability wheel were used as visual aids to help patients judge and assign preference to health states while using the standard gamble method. The Thai version was originally developed by Dr. Somchai Suksiriserekul, one of our co-author (15), and adopted without any revision.

Statistical methods for estimating QAS (quality adjusted survival) through-out whole life

The estimation of QAS followed the concept and method proposed by Hwang et al (10). As the 10-year survival rates for stage I to IV were 93%, 74%, 46%, and 10%, accordingly, we apply Monte-Carlo estimation (11) of extrapolation to obtain the QALE (quality adjusted life expectancy). To be brief, an individual's QAS is given as the integration of the patient's utility for HRQL through his/her survival function. The expected QAS for a population with a specific disease x_i, can be estimated by a simple approximation (10):

$$E[QAS(x_i)] \approx \int_0^\infty E[q(t \mid x_i)]S(t \mid x_i)dt$$

Where $E[q(t| x_i)]$ is the mean utility for HRQL of the population at time t after onset of disease x_i, and $S(t| x_i)$ is the survival function. Let the disease x_i denote breast cancer and x_0 denote general population. Then, $W(t)=QAS(t|x_i)/QAS(t|x_0)$ must be a function with its value between 0 and 1, because both the survival and quality of life of breast cancer patients are generally worse than people without the disease, or general population. The logit transformation of W(t) should be a linear function except for the two tail ends:

$$\log\frac{W(t)}{1-W(t)} = \alpha + \beta_t + \varepsilon \quad for\ T_s \leq t \leq T_f$$

Where ε was the error term; T_s indicates the necessary time for patient's clinical condition to be stabilized; and T_f corresponded to the time of censored point. As the treatment of breast cancer generally involves surgery plus chemotherapy and/or radiotherapy, it can last to about 2 years. Thus, we assigned T_s = 24 months for breast cancer.

The $QAS(t|x_o)$ was obtained by taking the 1990 life table data of Thailand, which provided the hazard function, and we assumed that the utility value for HRQL of general population was 1 throughout one's life. Then $QAS(t|x_o)=S(t|x_o)$ for all time

t. Given the least squares estimates of the two parameters, α and β, the new estimate QAS($t|x_i$) for $t>T_f$ was given by

$$\hat{QAS}(t \mid x_i) = \hat{QAS}(t \mid x_0)\frac{\exp(\hat{\alpha}+\hat{\beta})}{1+\exp(\hat{\alpha}+\hat{\beta})}$$

Such calculations were performed for 4 different stages separately with each patient matched to a reference (or normal) person of the same age and gender. The standard error of QAS was also obtained by using re-sampling techniques similar to the bootstrap method (16). Finally a figure plotting the logit transform of W(t) against time since first diagnosis of cancer was also examined to check the assumption of linear relationship for each stages.

RESULTS

The average age of these 781 patients were 50.3± 13.0 years old with a range of 22-95. There were two cases with incomplete information, which were excluded from further analysis.

By the time of censoring (June 30,1997), there were 74, 250, 103, and 28 cases still alive for stage I through IV. 86.6% of the patients were infiltrating ductal carcinoma histologically. 63.3% of stage I patients received surgery alone or with hormone therapy; 80.8% of stage II patients were treated by surgery with or without chemotherapy; 73.5% of stage III patients were treated by a combination of surgery with chemotherapy and/or radiotherapy. The mean utility values (± 1S.D.) of HRQL measured by SG and VAS methods for stage I through IV were 87.8± 6.4 vs. 83.8± 11.6, 82.5± 14.3 vs. 79.7± 13.3, 80.6± 14.6 vs. 80.3± 12.9, 78.2± 13.3 vs. 77.1± 13.8, accordingly. The values obtained via SG method are in general higher than those collected via VAS method.

The estimated QAS's followed for 12 years and extrapolated through whole life span for 4 different stages were summarized on Table 1. Taking utility values obtained through SG method as the standard, as they corresponded with expected utility theory, we found the utility loss from developing breast cancer, after adjusting for different age of onset were 89.2, 216.2, 217.9 and 281.2 QALMs for stage I to IV, accordingly. Thus, the utility gained from making diagnosis of breast cancer one stage earlier were 89.2, 127.0, 1.6, and 63.3 QALMs, respectively for stages I through IV.

Figure 1 depicted the QAS curves for 4 different stages of breast cancer and the general population with same age and gender. Areas between every two curves were utility gained from making diagnosis one stage earlier. The average gain of utility from preventing a case of breast cancer was 224.7 QALM. Figure 2 showed that the assumption of linearity for W(t) 24 months after first diagnosis seemed quite acceptable. Utility values obtained from VAS method for the QAS extrapolated through whole life were similar for breast cancer patients except stage I.

If we did not take HRQL into account and simply estimated the life expectancy of breast cancer, patients with stages I through IV had expected survival of 293.4± 2.4, 162.5± 0.4, 117.5± 0.3, and 35.9± 0.0, accordingly. The life expectancies (LE) gained from early diagnosis which detected the cancer one stage earlier were 83.3, 114.5, 11.5, and 65.4 months, accordingly for 4 stages. Both the expected QALE and LE in breast cancer in this study consistently showed that the highest utility would be gained from improving the technology of early diagnosis for breast cancer, especially making the detection of the stage II cases one stage earlier.

DISCUSSION

Survival data with heavy censoring are often encountered in follow up studies of cohorts with long term survival, such as early stage breast cancer. It was usually difficult to produce any convincing result beyond the end of follow-up from heavily censored data. In this study we borrowed information from regular life table of the general population, applied simple procedures including a logit transform of the ratio of QAS's for breast cancer and general population and use the linearity of the transformed curve to make inference. The verification of linearity assumption as shown by figure 2 further corroborated the prediction, and empirically demonstrated the usefulness of our method. During the last decades, burden of diseases have been quantified through DALY (disability adjusted life year) method proposed by Murray (17). The DALY method was appealing for its employment of expert committee to decide the survival function and disability function (for HRQL) and thus, provided convenience for direct international comparison. It did not, however, take into account of different accessibility of health service resources, different survival functions for various diseases and different subjective preference in HRQL in different countries or cultures. Thus, it might be suitable for a democratic country to use directly for resource allocation, because community people's subjective preference was not considered. Our method of quantifying QALE through extrapolation of censored data might be a better alternative for such purposes.

Based on the estimation by the extrapolation of QAS method, we found that the greatest utility could be gained from making diagnosis one stage earlier for stage II cases. Namely, one could have more almost 7 QALYs gained from detecting a case of breast cancer at stage I if compared with that at stage II. The utility gained from making diagnosis one stage earlier for stage III was only 5 QALM. The difference could not be explained by lead-time bias, as the estimation method already took age factor into consideration through Monte Carlo simulation. Since most utility loss came from a shorter life expectancy or survival period rather than the deterioration of quality of life in this study, we recommended that preventive efforts should be more focused on making earlier detection of breast cancer at stage I, of which monthly self-examination of breast might be the most effective ().

Figure 2 showed that the logit(W(t)) largely followed the linear assumption except the two tail ends. While the logit(W(t)) curves for the first 20-24 months might not be linear, the periods after this initial stage were relatively straight forward. Our data included cases with stage IV, which had the shortest LE, i.e., 35.9 months, and provided us with an opportunity to examine the tail end on the right side. The curve of logit(W(t)) seemed to lower down more steeply at about 115 months of follow up. However, it did not affect the estimation of QALE, because the survival rate was approaching 0 by that time.

In conclusion, we have empirically demonstrated the extrapolation method to be useful for estimating QALE even for chronic diseases. With cases collected in Chiangmai registry of Thailand, we found that the greatest utility could be gained from early diagnosis of breast cancer, especially detecting cases at stage I. Thus, monthly self-examination of breast might be the most effective way of breast cancer prevention.

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Table 1: Comparison of QAS (Quality adjusted survival) for different stages of Thai breast cancer patients in numbers of QALM (quality adjusted life month) after 12 years of follow-up and extrapolated to whole life. The utility of QOL (quality of life) was measured by SG (standard gamble) and VAS (visual analogue scale) method. The QOL of general population was assumed to be 1.

QAS	Clinical stage				
	Stage I	Stage II	Stage III	Stage IV	All stage
No. of cases	**79**	**335**	**222**	**143**	**779**
mean age (years)	**46.7± 12.0**	**48.5± 12.3**	**52.1± 13.0**	**53.6± 13.5**	**50.3± 13.5**
12 years of follow up					
QOL=1	**134.2± 3.7**	**111.9± 2.9**	**76.9± 4.1**	**33.1± 2.9**	
SG (S.D.)	**117.7± 3.8**	**92.5± 3.2**	**62.1± 3.9**	**26.7± 3.2**	
VAS (S.D.)	**111.3± 3.9**	**89.6± 3.1**	**61.8± 3.7**	**25.8± 3.5**	
Extrapolated to whole life					
QOL=1	**354.0± 13.9**	**161.2± 17.3**	**118.6± 23.4**	**36.5± 4.9**	**137.3± 10.6**
SG (S.D.)	**245.4± 44.1**	**143.8± 18.7**	**107.1± 22.0**	**29.6± 6.2**	**116.7± 9.5**
VAS (S.D.)	**178.1± 32.8**	**142.3± 18.1**	**104.1± 20.0**	**28.6± 5.7**	**110.9± 9.3**
General population	**376.7± 2.2**	**361.1± 2.1**	**323.1± 1.9**	**313.0± 1.9**	**344.9± 1.8**

附件三

EMERGING ENVIRONMENTAL HEALTH PROBLEM IN CHILDREN DURING ECONOMIC DEVELOPMENT: AIR POLLUTION AND LEAD POISONING AS EXAMPLES

Jung-Der Wang, M.D. Sc.D.

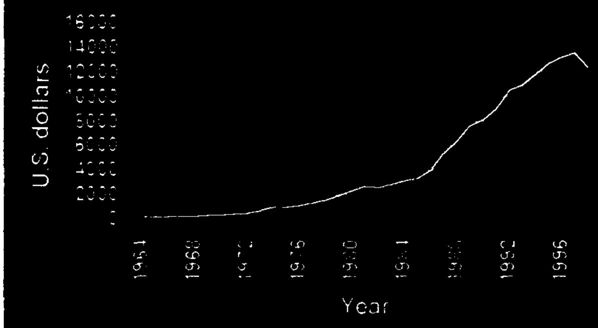
Chih-Wen Chung, Ph.D.   Chang-Chuan Chan, Ph.D

Institute of Occupational Medicine and Industrial Hygiene

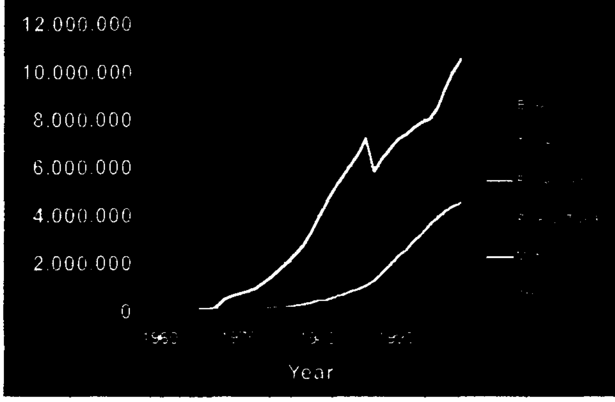
National Taiwan University College of Public Health

Department of Internal Medicine, National Taiwan University Hospital

Per Capita Gross National Product (GNP) 1964-1998



Number of motor vehicle by model



Air pollution

Environmental lead poisoning

Health Effects of Children from Air Pollution

Soap & Hit : Study of Air Pollution and Health in Taiwan

In a study of air pollution on respiratory health of primary school children in Taiwan, we sampled 5,072 primary school students in six communities :

- one community in rural area (Taihsi)
- two communities in urban areas (Keelung and Sanchung)
- three communities in petrochemical industrial areas (Toufen, Jenwu and Linyuan)

Adjusted odds ratios (95% confidence intervals) for respiratory symptoms and diseases by air pollution patterns compared to the rural area.

Adjusted for gender, school grade, father's education, crowding index, household smoking, pets, fowls, coal stove used, tea gas cooker used incense burning the whole day, mosquito repellent burning, indoor plants, and home dampness.

* $p<0.05$; ** $p<0.01$; # $p<0.001$; ## $P<0.0001$.

Respiratory Symptoms	Urban areas vs. rural area	Petrochemical areas vs. rural area		
		Touofen	Jenwu	Linyuan
Morning cough	1. 33 (0.98-1.80)	0.96 (0.67-1.37)	1.09 (0.76-1.55)	1.17 (0.80-1.71)
Day / night Cough	1.67 (1.21-2.29)**	1.13 (0.77-1.64)	1.35 (0.94-1.95)	1.38 (0.93-2.04)
Chronic cough	1.88 (1.07-3.31)*	1.26 (0.66-2.41)	0.88 (0.44-1.79)	1.08 (0.51-2.26)
Shortness of breath	1.40 (1.04-1.91)*	1.01 (0.71-1.44)	1.05 (0.74-1.51)	0.80 (0.54-1.21)
Nasal symptoms	1.96 (1.54-2.48)##	1.17 (0.88-1.54)	1.59 (1.21-2.09)#	1.59 (1.19-2.14)**

Respiratory Diseases	Urban areas vs. rural area	Petrochemical areas vs. rural area		
		Touofen	Jenwu	Linyuan
Sinusitis	1.53 (1.04-2.26)*	0.76 (0.47-1.23)	1.18 (0.75-1.87)	0.98 (0.59-1.65)
Wheezing or asthma	1.68 (1.11-2.54)*	0.63 (0.37-1.07)	0.97 (0.59-1.60)	1.16 (0.69-1.96)
Allergic rhinitis	1.82 (1.31-2.52)#	0.94 (0.64-1.40)	1.25 (0.85-1.84)	0.90 (0.57-1.42)
Bronchitis	1.72 (1.33-2.23)##	1.23 (0.91-1.65)	1.01 (0.74-1.38)	1.17 (0.83-1.64)
Pneumonia	1.10 (0.63-1.92)	0.62 (0.31-1.26)	0.53 (0.25-1.13)	1.21 (0.62-2.36)
Family's respiratory Diseases	1.40 (1.04-1.89)*	0.82 (0.58-1.17)	1.03 (0.73-1.46)	0.70 (0.46-1.08)

In the study of 4,697 schoolchildren's absences and their one-day lag's individual levels of exposure by absence counts during 1994-1995 school year,

we found that schoolchildren's risks of illness absence are significantly related to acute exposures to nitrogen dioxide (NO_2) and nitrogen dioxides (NO_x) with 1-d lag ($p<0.01$) at levels below WHO's guidelines.

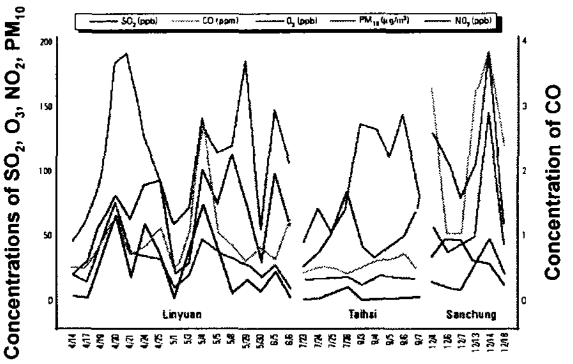
Effects of air pollutants on schoolchild's illness absence estimated by increase in 10 units of pollution levels with 1-day lag in time-domain (T) and subject-domain approach with personal data (SP).

Pollutans	T		SP	
	Relative risk	95% C.I.	Relative risk	95% C.I.
NO_x	1.08	(0.98, 1.19)	1.11	(1.03, 1.19)
NO_2	1.14	(0.97, 1.35)	1.23	(1.07, 1.41)
NO	1.01	(1.00, 1.01)	1.01	(1.00, 1.02)
SO_2	1.02	(0.66, 1.06)	1.04	(1.00, 1.09)
PM_{10}	1.00	(0.99, 1.02)	1.01	(0.99, 1.02)
O_3	0.94	(0.76, 1.15)	0.96	(0.85, 1.09)

Adjusted for weather variables. Units are 10 μg/m³ for PM_{10} and 10 ppb for other pollutants.

Effect of Air Pollution coming from Motor Vehicles

In the study of the ambient air pollution on the pulmonary function of schoolchildren, we sampled 941 children in primary school in three communities in Taiwan (Sanchun, Taihsi, and Linyuan).

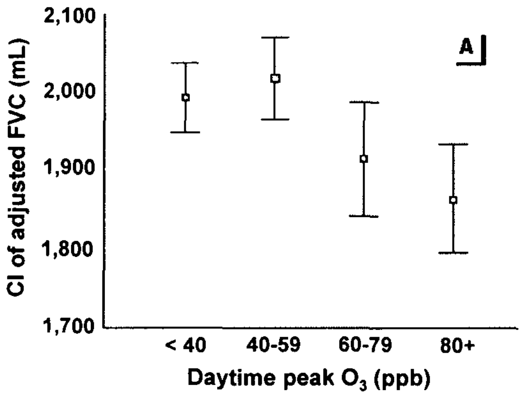


Daytime peak concentrations of air pollutants in the day before spirometry.

13

We found a significantly negative association of peak O_3 concentration in the previous day before spirometry with individual forced vital capacity (FVC) and forced expiratory volume (FEV) in 1 sec, after controlling for gender, height, body mass index, community, average atmosphere temperature, rainfall, and concentrations of sulfur dioxides, PM10, and nitrogen oxides.

14



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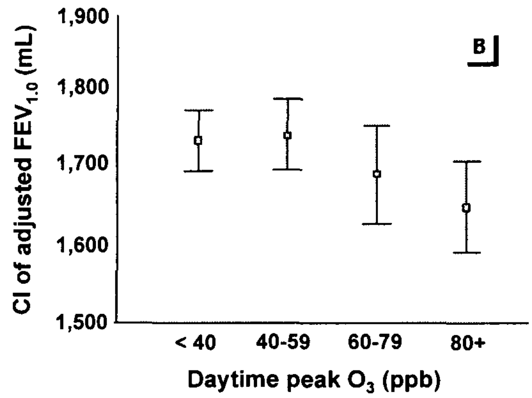


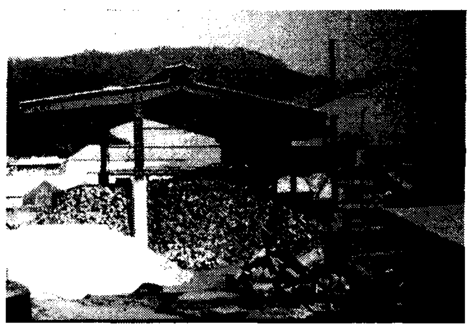
16

Health Effect of Lead on Children:

Exposure coming from schooling in a kindergarten next to a lead battery recycling smelter

Blood lead and intelligence quotient recover after moving the kindergarten 2 kilometers away

17



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Contents of lead (Pb), copper (Cu), Zinc (Zn) (in mean ±S.D μg/gm) in the soil near the lead recycling factory stratified by different depths of the soil and distance from the factory.

Numbers in parentheses indicate the number of sample.

Distance from the factory	Surface Roadside Yes	Surface Roadside No	Depth of the soil 1cm	Depth of the soil 1-15cm	Depth of the soil 16-30cm
< 350m					
Pb	4187±3331 (9)	1914±1468 (5)	508±372 (13)	86±72 (20)	28±12 (10)
Cu	3.1±2.1 (9)	1.3±1.0 (5)	0.9±0.4 (7)	0.6±0.2 (6)	0.5±0.1 (5)
Zn	8.4±2.3 (8)	5.0±2.7 (5)	4.3±4.5 (7)	1.8±2.3 (6)	1.4±2.4 (5)
350-1100m					
Pb	193±122 (7)		38±13 (5)	17±11 (10)	10±11 (5)
Cu	1.9±1.0 (6)		1.2±0.2 (3)	1.4±1.5 (3)	1.4±0.3 (2)
Zn	9.9±1.3 (5)		1.7±0.1 (2)	4.4±3.8 (3)	2.2 (1)

*p<.01 by Mantel extension for the test of trend.

Mean blood lead (μg/dl)	Length of stay in the exposed kindergarten: All day	Length of stay in the exposed kindergarten: Half day	Wilcoxon rank sum test all day vs. half day
Male	23.6±6.6 (n=4)	15.3±3.3 (n=12)	P = 0.03
Female	14.6±2.9 (n=8)	13.2±2.9 (n=12)	P = 0.28
Wilcoxon rank sum test male vs. femal	P = 0.03	P = 0.07	

Frequency distribution	Kindergartens: Exposed	Kindergartens: Nonexposed
Blood level (μg/dl)		
< 10	1	25*
10-15	13	10
15-20	19	0
> 20	3	0
Intelligent quotient (IQ)		
< 70	1	0*
70-89	12	4
90-109	15	20
> 110	4	11

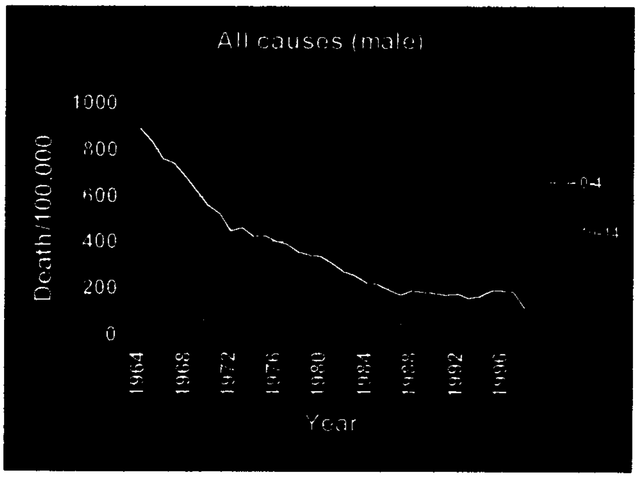
*P<0.01 by Mantel extension for the test of trend

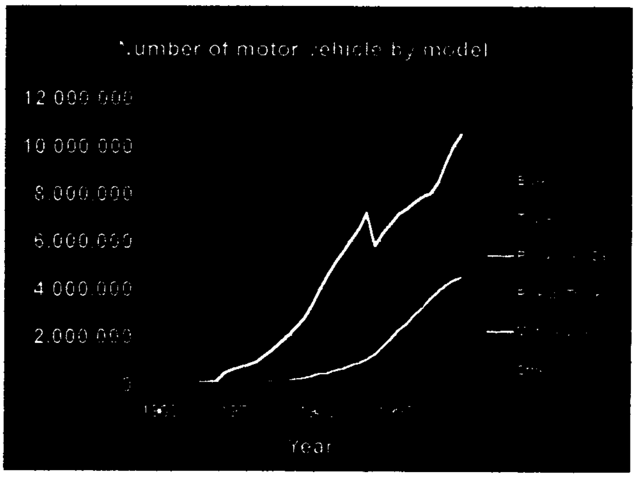
	Kindergartens Exposed	Kindergartens Non-exposed
Median and range of the blood lead (µg/dl)		
Before moving	15.1 (7.7-31.7)	8.4 (4.8-12.8)
After moving	8.5 (5.0-15.0)	7.0 (4.0-11.0)
Decrease of Blood lead (µ g/d) compared wit previous examination	6.9±2.0	1.7±1.3
Increase of IQ with previous examination	11.7±13.2	4.2±13.0

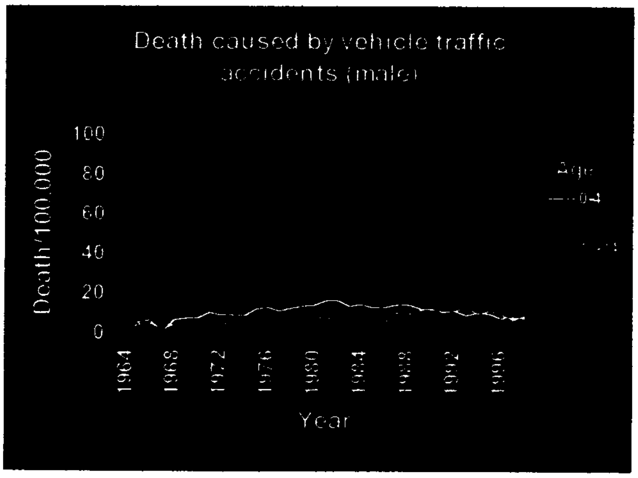
Self – Comparison between Initial and Follow-up Studies

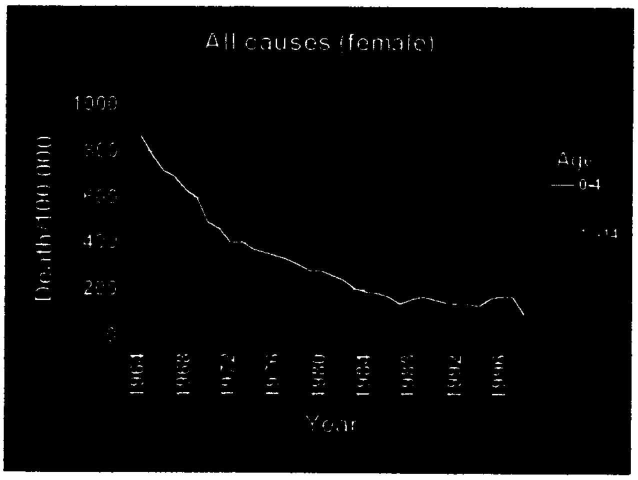
Measure and group	n	5S	Range
Difference of PbB (ug/dl)			
Exposed	28	-6.9±3.	-16.7-4.3
Reference	28	-1.7±1.	-5.4-0.8
Difference of IQ (Binet-Simon) Scale			
Exposed	28	11.7±13.±†	12.0-48.0
Reference	28	4.25±13.±	-23.0-28.0
Difference of Hgb (g/dl)			
Exposed	28	-0.16±1.1±	-2.9-1.5
Reference	28	-0.08±1.0±	-2.1-23.0

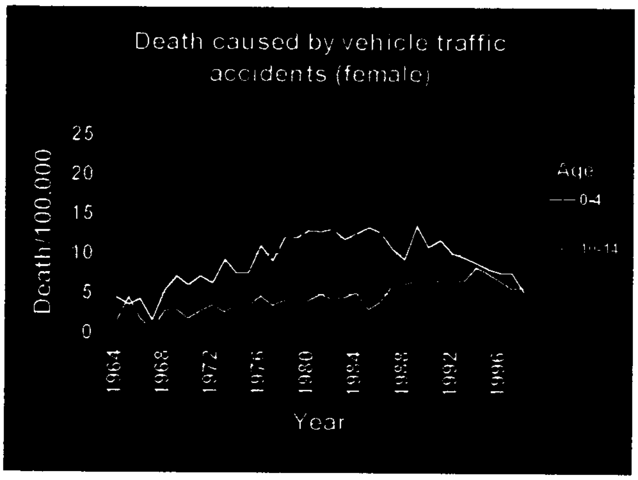
Paired *t* test *: < 0.001 ; †: = 0.001







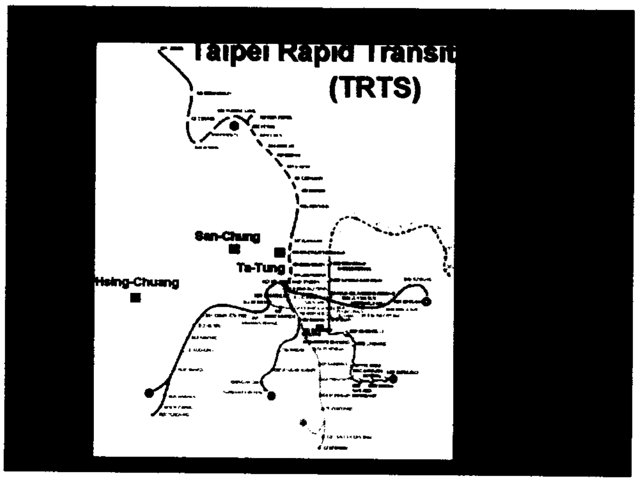


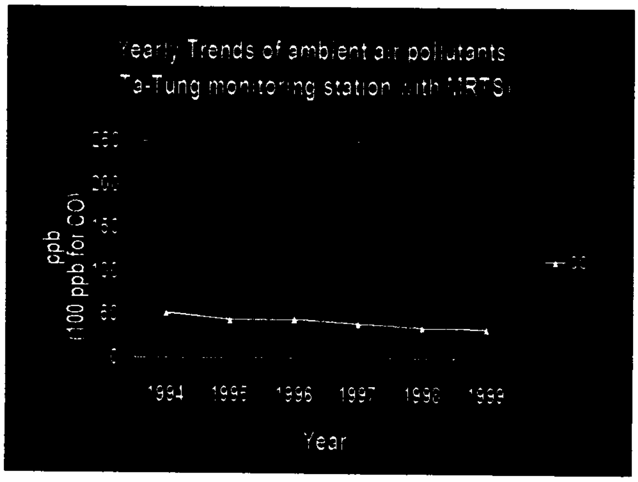


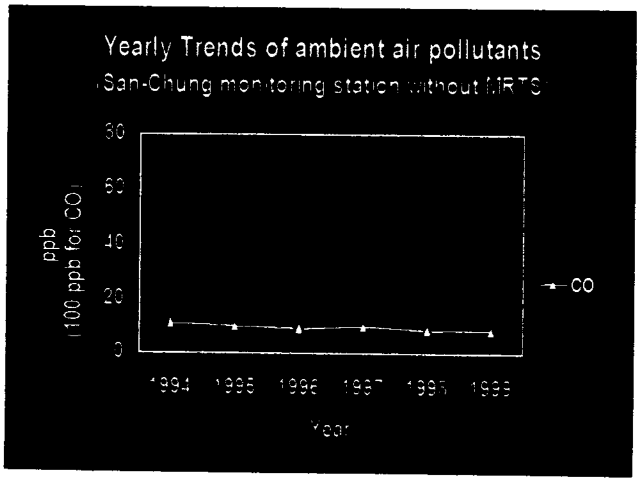
Proposal Solutions

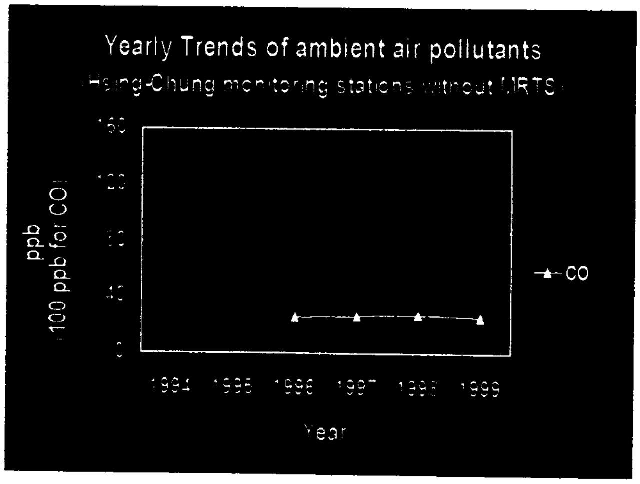
Stationary sources:
- Source control
- Zoning

Mobile Sources:
- Emission control
  - Automobile
  - Motorcycle
- Unlead gasoline









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CONCLUSION :
POLLUTION PREVENTION FIRST

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