國立台灣大學公共衛生學院職業醫學與工業衛生研究所

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Institute of Occupational Medicine and Industrial Hygiene
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改善非洲馬拉威北部公共衛生的相關研究：
傳統接生婆受訓後的表現與愛滋病人接受治療的存活分析

Studies related to the improvement of public health in northern Malawi: Performance of trained traditional birth attendants for delivery service & Survival analysis of AIDS patients under antiretroviral therapy

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本論文係陳志成君（D95841006）在國立臺灣大學公共衛生學院職業醫學與工業衛生研究所完成之博士學位論文，於民國九十九年五月二十七日承下列考試委員審查通過及口試及格，特此證明

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（是否須簽章依各院系所規定）

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誌　謝

這一本論文是還願、感恩的紀錄。

當我還是大六醫學生時，參加台灣世界展望會第一屆飢餓三十，有機會到非洲莫三鼻克和馬拉威訪問展望會在當地的救援工作。當時深受感動，向上帝立下「醫人、醫心、醫國」的心願，並走上公共衛生之路。2002 年因衛生署的邀請，擔任衛生署首任駐非代表，有機會向上帝還願，這一本論文就是還願的成果。感恩是因它結合許多人的心力與貢獻才得以完成，我有幸代為執筆整理，讓大家的努力有機會以學術面貌跟更多人分享。

台灣駐馬拉威醫療團是所有計畫的實際執行者，在歷任團長陳維廉醫師、詹文宗醫師和余廣亮醫師的領導下，我們共同努力並完成一些理想。我和醫療團都來自屏東基督教醫院，要感謝屏基全力的支持，特別是林伶紅小姐擔任後勤窗口，積極任事，讓團隊無後顧之憂。2006 年我自非返國後承蒙屏基劉侃董事長，歷任院長張肇松醫師、卓德松醫師和余廣亮醫師的接納，也要謝謝兒科秦有育主任和所有夥伴的包容，讓我可以邊上班邊讀書。另外要感謝江姿儀小姐，她在 2007 年擔任我接生婆訓練計畫的助理，她認真負責，對這本論文貢獻良多。

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感謝公衛學院職醫所給我良好的學習環境和許多老師與口試委員的指導，像

是詹長權教授教我國際衛生合作，陳保中教授教我婦幼衛生和統計，鄭尊仁所長的殷殷垂詢，還有流病所金傳春教授和預醫所賴美淑教授的關心勉勵。台北醫學大學邱文達校長在繁忙的校務中蒞臨指導論文口試，還有在國際醫療這條路上一直提攜我的良師益友--張武修教授。人步入中年以後還能當學生，並獲得眾多老師的指導，真是幸福。

衛生署國際合作處是派我出去的單位，要感謝阮娟娟處長的知遇之恩、張武修處長的指導，陳美娟科長和羅淑瑞姊姊的行政支持，讓我得以向上帝還願。能擔任這項職務是一個特殊的機遇，也要感謝歷任署長李明亮、陳建仁、侯勝茂的鼓勵和支持。是李署長與外交部交涉，才有這個職務，也是他派我到非洲去；當小兒陳懿在馬拉威感染瘧疾時，陳署長寫信來安慰我；侯署長在我卸任時，頒給我三等衛生獎章。還有前副署長王秀紅教授到馬拉威來視察，給我們很大的鼓勵，我們還一起參訪南非和史瓦濟蘭。另外高醫江宏哲教授，多次帶領學生到非洲來指導協助我們的工作。

沒有家人的支持，我不可能完成任何事。感謝當初父、母親答應讓我們到非洲去，還有弟弟陳志銘、弟妹何妙芬代替我照顧雙親。感謝我最大的支持者太太盧美玲、女兒陳馨和兒子陳懿，他們一同和我在非洲同甘共苦，這四年的非洲生活也是馨兒、懿兒童年最美好的回憶。謝謝妹妹陳雅雯、妹婿連炳林，還有林森南路禮拜堂長老李瀞淵哥哥和劉璧英姊姊開放他們的家庭接待我，讓我這幾年侯鳥般的求學奔波，在台北有落腳喘息之處。

醫療衛生是聯合國千禧年發展目標的核心議題，也是基本人權。台灣要走出去，成為受人尊敬的國家，一個好的方法是將台灣的愛心與醫療衛生經驗，推廣到世界上有需要的地方。這本論文希望為台灣留下國際醫療衛生某個階段的歷史，讓有興趣的人有跡可循，或許能有拋磚引玉的功效。

摘　要

馬拉威位於非洲東南內陸，總人口約 1,300 萬人，為全世界低度開發國家之一。馬拉威人的平均餘命只有 50.9 歲，新生嬰兒死亡率為每千位活產數 83.5 個死亡，五歲以下幼童死亡率為千分之 100。每名婦女平均生育 5.5 名小孩，但衛生環境不理想，加上醫療資源缺乏，產婦死亡率高達 1,100/100,000。馬國人民主要死因為傳染性疾病，如愛滋病、肺結核、瘧疾、肺炎和腹瀉等。在成人(15~49 歲)中愛滋病的盛行率約 11.9%，2007 年估計全國感染愛滋病人數達 93 萬多人。

為了幫補馬拉威醫療資源的缺乏，台灣於 2000 年在馬國北部 Mzuzu 市興建完成 Mzuzu 中央醫院，並派駐醫療團協助。屏東基督教醫院自 2002 年 7 月接手管理此醫療團。面對馬拉威過高的產婦和嬰幼兒死亡率，醫療團在台灣衛生署支持下在 2004-2006 年間，共訓練 81 位傳統接生婆，至 2008 年八月共接生了 1905 位嬰孩。結果新生嬰兒死亡率為每千位活產數 13.6 人，不到馬國全國統計值的一半，接生婆所服務的產婦也沒有人死亡。另外，醫療團為了協助馬國對抗愛滋病，從 2004 年 7 月 1 日起開辦馬國北部第一個愛滋病免費治療門診「彩虹門診」，並研發出「指紋辨識資訊系統」，以登錄病人臨床過程和用藥情形。

聯合國 2000 年訂定千禧年八大發展目標，其中的四到六項為衛生健康議題，包括第四項：降低孩童死亡率；第五項：促進母親健康；第六項：對抗愛滋病、瘧疾和其他疾病，這三項議題可歸納為婦幼衛生和愛滋病，正是全球衛生的核心課題，也是本論文的主軸。本論文包含兩大部份：(一)婦幼衛生，分析產婦到醫療院所的可近性和傳統接生婆受訓後的表現與再教育對他們的重要性；(二)愛滋病，分析彩虹門診病人接受藥物治療的存活率，分為成人(15 歲以上)和小孩(15 歲以下)。以下為四篇論文的重點摘要：

第一篇論文：發現距離是產婦選擇生產地點的最重要因素。使用 GPS 結合 Google Earth 能客觀測量產婦到達醫療院所需要的距離和時間，有助於醫療可近性

的評估。結合此兩種工具，幫助我們了解醫療資源的分布，可作為公共衛生決策上的參考。

第二篇論文：發現經過訓練和再教育的傳統接生婆能夠有良好的表現，她們所接生的嬰孩，死亡率不到全國平均值的一半。接生婆可以是醫療人才不足國家的重要人力資源，但他們需要良好的訓練與再教育，再教育每年應至少舉辦一次。

第三篇論文：發現在接受愛滋病治療的成人中，男性的存活率顯著比女性差，這可能和男性較晚被診斷、接受治療時的臨床嚴重度較高和較差的遵醫囑性有關。這點提醒我們在推廣愛滋病藥物治療時，應注意性別差異可能帶來的影響。

第四篇論文：發現嚴重營養不良，如 BMI 小於 15kg/m^2，是愛滋病兒童早期死亡最重要的預測因子。營養不良對於死亡的影響在開始治療的前三個月內特別顯著，所以早期的營養評估和介入應該整合在愛滋病童的治療計畫中。

從 2000 年開始到現在 2010 年，已經過了千禧年發展目標預定時間(2015 年)的一半，但世界衛生組織評估發現許多國家千禧年發展目標進展緩慢，最大的瓶頸就是專業醫護人員缺乏。本論文從傳統接生婆的訓練和他們受訓後的表現，發現他們可以是潛在的人力資源，前提是要給他們好的訓練和再教育，有良好的監督管理與後勤支援，並把他們納入醫療體系。如果我們能挑選合適的人，將他們訓練成社區衛生工作者，進行接生、轉介危險妊娠到醫療院所、衛生教育、愛滋病母子垂直感染的預防、給營養不良的孩童補充營養等基本衛生照護，將可減少對專業醫療人力的依賴和改善落後地區的婦幼衛生與愛滋病防治。如此，千禧年衛生發展目標才有機會在 2015 年前圓滿達成。

關鍵字：非洲、馬拉威、愛滋病、婦幼衛生、傳統接生婆、可近性、Google Earth

ABSTRACT

Malawi, located in southeastern Africa with an estimated population of 13 million, is among the world's least developed countries. The life expectancy of Malawian people is only 50.9 years. The high rates of infant and under-five mortality are 83.5 deaths per 1,000 live births and 100 deaths per 1,000 live births, respectively. Although the total fertility rate averages 5.5 children per womon, the maternal mortality rate is as high as 1,100 deaths per 100,000 live births due to poor environmental health and a shortage of medical resources. The leading causes of death in Malawi are infectious diseases such as acquired immunodeficiency syndrome (AIDS), tuberculosis, malaria, pneumonia and diarrhea. The prevalence of AIDS in adults aged 15-49 years is 11.9% and more than 930,000 people were living with AIDS in this country in 2007.

In 2000, the Taiwan government built the Mzuzu Central Hospital in the northern region of Malawi in order to compensate the severe shortage of medical resources and dispatched a medical team to assist in managing the Mzuzu Central Hospital. Since July 2002, Pingtung Christian Hospital has taken over the medical team. To face the challenge of high maternal and infant mortality rates, the medical team trained 81 traditional birth attendants (TBAs) during 2004-2006 with support from the Department of Health, Taiwan and totally 1905 babies were delivered until August 2008. The neonatal mortality rate was 13.6 per 1,000 live births, lower than half of the national statistics and the maternal mortality rate was zero. Moreover, the Rainbow Clinic, the first free antiretroviral therapy (ART) clinic has been opened in northern Malawi since 1st July 2004 in order to fight against AIDS, and furthermore a fingerprint identification information system was developed to record patients' clinical courses and medication history.

The United Nations set up eight Millennium Development Goals (MDGs) in 2000. Three of them are related to health issues: MDG4, to reduce child mortality; MDG5, to improve maternal heath; MDG6, to combat HIV/AIDS, malaria and other diseases. These three MDGs, i.e. Maternal and Child Health and AIDS, are the core issues of current international health. This doctoral dissertation also includes these two issues: (1) Maternal and Child Health, evaluating the accessibility of health facilities for pregnant woman and the importance of continuing education for TBAs and their performance; (2) AIDS, analyzing survival rates of AIDS patients on antiretroviral therapy for adults (aged more than 15 years) and children (aged less than 15 years). Summaries of the four dissertations are listed below.

The first paper: The distance is the most important concern of women's choice of delivery places. GPS and Google Earth were used to measure the distance and time needed for pregnant women to reach health facilities. The combination of these two tools helps us to know the resource distribution and the accessibility of delivery services, which may be helpful for public health planning and policy making.

The second paper: Through initial training and continuing education, TBAs are able to have a good performance in decreasing the neonatal mortality rate to less than half of the national statistics. Well trained TBAs under regular supervision and continuous support can be a potential human resource for countries lacking medical professionals. We recommended that continuing education should be regularly provided, at least annually.

The third paper: The mortality rate was significantly higher in adult males than in adult females with AIDS on ART. This may be associated with the delayed diagnosis, seeking for medical care in a more advanced clinical stage and poorer compliance to

therapy in male patients. The gender difference needs to be addressed in scaling up ART programs in Africa.

The fourth paper: Severe malnutrition, indicated by BMI <15 kg/m^2, may be the most significant prognostic indicator for premature mortality in children on ART. The first three months after starting ART is the golden period of nutrition assessment and intervention, especially for malnourished children. Early and proper nutrition support should be integrated with ART management.

From 2000 to 2010, half the MDGs time frame (2015) has passed, but WHO found that the progress of MDGs in some under-developed countries is very slow, mostly due to the shortage of medical professionals. This doctoral dissertation found that TBAs can be a potential human resource, if they can have a proper training and continuing education, under regular supervision and logistic support, and are also well integrated into the current medical system. For example, if we can select good candidates and train them to become TBAs or community health workers, they can do some primary cares such as delivery service, referring high risk pregnancy to health facilities, health education, prevention of maternal-to-child HIV transmission (PMTCT), and nutrition support for malnourished children. They are able to reduce great burden of medical professionals and improve the maternal and child health as well as AIDS control in remote rural areas. Then, there will be an opportunity for us to accomplish MDGs by the end of 2015.

KEY WORDS: Africa, Malawi, AIDS, Maternal and Child Health, Traditional Birth Attendant, Accessibility, Google Earth

第一章：馬拉威簡介和醫療衛生概況

1.1 馬拉威簡介

馬拉威為非洲東南之內陸國家，鄰接尚比亞、坦尚尼亞與莫三比克，面積118,484 平方公里，總人口約 1,300 萬人，90%的人口散居於鄉村地區。宗教方面，信奉基督教者占總人口 55%，天主教與回教各 20%。齊切瓦語(Chichewa)為該國國語，惟官方語言仍沿用英文[1]。台灣與馬拉威於 1966 年締交，外交關係歷經四十餘年，但不幸於 2008 年因中國強力介入而斷交。

馬拉威為全世界低度開發國家之一，全國財政高度倚賴外援，如世界銀行及個別國家支援，特別是美國、英國、日本和歐盟。因為貧窮，教育資源缺乏，全國識字率不到七成，其中不到一成的人讀完中學，在鄉村地區一半婦女不會讀書識字，很多地區連書本都沒有[1]。

1.2 馬拉威醫療衛生概況

馬拉威醫療體系分為三級。第一級為鄉村的保健中心，提供基本的衛生照護；第二級是地區醫院和教會醫院系統，提供一般性的疾病治療與健康照護；第三級是中央醫院(Central hospital)，作為後送醫院(referral hospital)。

馬拉威人的健康指標並不理想(見表 1.1)，平均餘命只有 50.9 歲，新生嬰兒死亡率為每千個活產嬰兒有 83.5 個死亡，五歲以下幼童死亡率為 100/1,000[2]。高幼童死亡率加上沒有家庭計劃常常導致婦女高生育率，每名婦女平均生育 5.5 名小孩。可是衛生環境不理想，加上醫療資源缺乏，又造成高達 1,100/100,000 的產婦死亡率(Maternal mortality ratio)[2]。

馬拉威人的死亡原因主要為傳染性疾病，如愛滋病(AIDS), 肺結核(tuberculosis, TB), 瘧疾(malaria), 肺炎(pneumonia)和腹瀉(diarrhea)，營養不良讓死亡率雪上加霜[1]。在馬拉威成人(15~49 歲)的 HIV/AIDS 盛行率為 11.9%，全國感染愛滋病人數

達到 93 萬多人，其中尤以中產階級具有消費能力之青壯人口感染率最高。每年因為愛滋病所增加的孤兒人數估計有 10000 多人[1]。

表一、馬拉威基本資料與健康指標

項目	資料(以及估計年份)	世界排名
Population	15,447,500 (2010 est.)	64
GDP per capita	U.S. $900 (2009 est.)	217
Population below poverty line	53% (2004 est.)	
Literacy (age 15 and over can read and write)	62.70% (2003 est.)	
Life expectancy at birth	50.9 years (2010 est.)	211
HIV/AIDS Adult prevalence rate	11.9% (2007 est.)	9
People living with HIV/AIDS	930,000 (2007 est.)	15
HIV/AIDS deaths	68,000 (2007 est.)	10
Infant mortality rate (per 1,000 live births)	83.5 (2010 est.)	12
Total fertility rate (children born per woman)	5.5 (2010 est.)	11

Data source: Central Intelligence Agency, U.S.A. [1]

1.3 馬拉威醫療人才缺乏

全馬拉威接受完整專科訓練的醫師不到 300 位，根本不能滿足 1300 多萬人口的需要。筆者於 2002-2006 年間擔任台灣首任衛生署駐非洲專員，駐地馬拉威，積極協助馬國醫學院籌募資源，增加招生人數。但是馬國醫療人才外流(brain drain)嚴重，滯留在歐美先進國家的馬籍醫師人數遠超過留在馬國的醫師數。當地媒體曾經報導，在 100 位護理系畢業生中，畢業一週內就有 26 位跑到歐美先進國家工作。

1.4 馬拉威醫療衛生困境

馬拉威醫療衛生的困境主要來自於貧窮和愛滋病流行，這兩者又互為因果。貧窮以致於基礎建設不足，醫療設備不夠；貧窮留不住人才，以至於醫療專業人才缺乏，疾病防治無人進行，導致死亡率居高不下；死亡率高，又進而造成人口流失，經濟生產力減弱，國家發展停滯。這些事情環環相扣，實在需要有好的對策來打破這個惡性循環。

從下面的表可以看出馬拉威每十萬人的醫師和護理師人口比，相對於全非

洲、全球以致於台灣都是缺乏的。

表二、馬拉威每十萬人的醫師和護理師人口比

地區	專業人數	每十萬人的專業人數	倍數(若以馬拉威為一倍)
醫師			
Malawi	266	2	1x
Africa	150708	21	10x
Global	7682990	123	60x
Taiwan	37151	161	80x
護士			
Malawi	7264	59	1x
Africa	663942	93	1.5x
Global	16037307	256	4x
Taiwan	129398	562	9.5x

Data source: World Health Statistics 2010 &台灣衛生署 2010 年資料

第二章：台灣駐馬拉威醫療團的經驗

2.1 醫療團緣起與三階段計畫

為了彌補馬拉威北部地區醫療資源的缺乏，台灣於 2000 年在北部 Mzuzu 市幫忙興建完成 Mzuzu Central Hospital，共有 300 床。隨後基於台灣與馬拉威的醫療合作協定，由台灣國際合作發展基金會(International Cooperation and Development Foundation, ICDF，簡稱國合會)派駐一個醫療團協助。

2002 年 7 月 1 日起，屏東基督教醫院(屏基)接受國合會委託，接手管理馬拉威醫療團，這是政府首度將派駐國外的醫療團交給民間的醫療機構管理。筆者當時擔任屏基海外宣教中心主任，負責事前的評估和醫療團計劃的擬定[3]。我們擬定一個計劃(表 2.1)，從醫院的管理、人員培訓、醫療服務到公共衛生，希望有策略、按步驟來做好醫療外交。

表三、馬拉威醫療團三階段計畫

	第一階段：深耕	第二階段：撒種	第三階段：收割
重點	醫院管理 人才培育	公共衛生 人才培育	學術研究 人才接棒
做法	充實醫療團人力 強化後勤支援 建立醫院管理 培育馬國人才	愛滋病門診與防治 傳統接生婆訓練 捐血活動 巡迴醫療	愛滋病治療及研究中心 以台灣名義發表研究成果 至國際學術刊物
目標	提升姆祖祖中央醫院水準	提升馬國北部公共衛生水準	提升台灣參與國際醫療衛生水準

2.2 第一階段：醫院管理與人才培育

第一階段醫療團著重在姆祖祖中央醫院 (Mzuzu Central Hospital)的經營管理和人才培育，以提昇該院臨床醫療服務水準和健全醫院管理為重點。有幾件事值得一提[4]：

1. 自 2004 年起，姆祖祖中央醫院連續獲得馬拉威全國「**最佳醫院感染管控獎**」，這是馬國衛生部和美國疾病管制局共同舉辦的全國性競賽。能獲得這項榮譽，代

表醫院在環境衛生和感染控制方面已有一定的水準。

2. 在團員和替代役男的發起下，醫療團從台灣募集許多醫學圖書在姆祖祖中央醫院設立「**台灣醫學圖書館**」，是馬國目前最好的醫學圖書館，醫療團每年也編列預算購買醫學期刊和書籍，充實圖書館內容，供醫院同仁進修最新醫學知識。

3. 每年醫療團會從姆祖祖中央醫院**選派醫療人員到台灣受訓**。這是一個重要的策略，對少有機會出國的馬國同仁而言，能夠出國就是一個很大的激勵。讓他們到台灣來，不僅學習醫學新知、醫院管理，更學習我們勤奮的工作態度以及認識台灣人的友善與熱情。

2.3 第二階段：公共衛生與人才培育

在醫療團的管理上軌道與中央醫院的醫療水準提升後，我們開始針對馬國廣大的醫療衛生需求，以姆祖祖中央醫院為基礎展開一些計畫，到社區去進行公共衛生。這裡列舉幾項較顯著的計畫[4]：

2.3.1 傳統接生婆訓練計畫

此計劃正是本論文的第一部分，將於第四章詳述。

2.3.2 愛滋病人「彩虹門診」與指紋辨識資訊系統

此計劃正是本論文的第二部分，將於第五章詳述。

2.3.3 捐血活動

馬拉威沒有血庫和捐血中心，遇到病人需要輸血時，才臨時找家屬和路人來捐血，臨時找來的人扣掉血型不合、 HIV 陽性、瘧疾感染、B 型肝炎的人，可用的血所剩無幾。因此許多需要開刀的病人，只好延遲；如果是急需輸血的個案，就只能聽天由命。

為了拯救許多垂危的病人，醫療團在北部地區推動捐血活動，主動到學校和社區去推廣。一方面收集乾淨的血液以拯救生命，另一方面透過抽血前的衛生教

育告訴捐血者要潔身自愛，要如何保護自己不要感染愛滋病。經過幾年的努力，血液收集的量已經能供應姆祖祖中央醫院和鄰近醫院的需要，挽救不少病人的生命。2006 年 4 月台灣血液基金會台北捐血中心及國際獅子會 300A1 區又慷慨捐贈一輛捐血車，命名為「台灣之愛」。這輛捐血車也是馬國的第一輛捐血車。

2.3.4 巡迴醫療

馬國醫療資源缺乏，特別在鄉村地區缺醫少藥。醫療團不侷限在中央醫院，主動把服務觸角往外延伸，將醫療團的醫術和資源送到資源缺乏的地區。醫療團固定每個月到鄉村醫院巡迴醫療，一方面指導協助地區醫院的醫護同仁，對他們是實質的鼓勵和幫助；一方面找出困難的個案，及早治療或轉診。這樣的巡迴醫療在馬國現有的醫療體系下運作，有系統和規律地補強他們不足之處，也達到提升地區整體的醫療水準。

2.4 第三階段：學術研究與人才接棒

愛滋病是非洲國家以致於全世界最重視的疾病。筆者當時擔任衛生署駐非代表，鼓勵醫療團體認和協助馬國的需要，共同面對愛滋病的挑戰。2004 年醫療團開辦彩虹門診，在衛生署的支持下，我們先購買 CD4 計數儀器、冰箱，然後病毒計量(Viral loading)器等設備，讓醫療團對愛滋病的治療能夠有客觀的臨床數據[4]。

2005 年醫療團余團長將彩虹門診指紋辨識系統的經驗投到 Lancet 獲得刊登，這是醫療團首篇在國際學術期刊發表的文章[5]。帶給我們很大的鼓勵，好像距離第三階段學術研究的目標不是那麼遙遠。我們再接再厲，希望以馬拉威醫療團為基礎，建立台灣在非洲的**愛滋病研究中心**。這個中心於 2006 年 5 月 5 日由台灣駐馬拉威莊大使訓凱和馬國衛生部長共同主持破土典禮。我們希望營造一個理想的環境，把這個中心變成愛滋病和熱帶醫學人才的訓練平台，讓有意進行愛滋病研究的學術團隊可以到這裡來做學術研究和臨床服務。

2.5 建立以醫院管理駐外醫療團的模式

台灣駐馬拉威醫療團在歷任團長陳維廉醫師、詹文宗醫師和余廣亮醫師的卓越領導下，醫療團充滿朝氣與活力。屏基以醫療專業和宗教熱誠全力協助醫療團的經營管理與後勤支援，特別是歷任馬拉威專案副院長顏簡美珠醫師和王國揚醫師殫精竭力的付出，使馬拉威醫療團的管理步上正軌並開花結果，成為台灣海外醫療團的典範。屏基也因此在 93 年、94 年榮獲衛生署頒獎肯定醫療援外的優異績效。從屏基管理馬拉威醫療團的例子，我們歸納幾點成功的因素[4]：

1. **團員素質佳**：醫院選派出去的團員會先經過嚴格評估，在專業和品格上有保證。團員在醫療專業上，可以常常回國進修充電，獲得專業上的諮詢和幫助，不會與國內脫節。團員平均年齡降低，團隊充滿朝氣有活力。

2. **團隊精神好**：團員來自相同醫院，較有默契。團員簽約時都受聘為醫院員工，享有與院內同仁一樣的保障與福利。團員如果在國外不守紀律、不服從團長指揮或工作表現不佳，醫院可以隨時把該員調回國內上班。相對的，醫院也保證團員離團時，在合約期限內，醫院保障適當的職缺，團員有醫院歸屬較無後顧之憂，醫院是團員專業生涯的娘家。

3. **後勤有效率**：醫院了解醫療團的需要，在醫療器材選購和後勤補給方面，不會產生錯誤。院方與醫療團建立清楚暢通的聯絡管道，溝通無障礙，提升效率並確保品質。

屏基學習基督耶穌的榜樣，以「僕人」的態度來支援醫療團的工作，盡量滿足醫療團的需求，好讓他們發揮最佳的戰力。有了馬拉威醫療團成功的經驗，現在台灣駐史瓦濟蘭醫療團和駐聖多美普林西比醫療團也都交給民間醫療團隊(台北醫學大學)管理。相信在北醫邱文達校長的領導下，兩個醫療團也可以締造豐碩的援外醫療成績。

2.6 台馬斷交撤走醫療團的省思

台灣與馬拉威的邦交，不幸於 2008 年因中國以大筆金錢利誘而中斷。台灣派駐馬拉威的技術團和醫療團隨即撤離，醫療團的工作和計畫被迫中止。由於醫療團經費主要來自台灣政府援外經費，必須遵從撤團指示。只是當我們撤團時，外國友人詢問我們為什麼要撤走？難道我們的醫療人道服務只是為外交效力？面對這個問題，實在不知道如何回答。

筆者身為醫療衛生專業人員，深信醫療衛生本身就有價值。雖然斷交，但是醫療團的服務是否仍可保留？例如彩虹門診當時就有超過 5000 位的愛滋病人，我們撤走後他們該怎麼辦？也許有人認為是馬拉威先對我們無情，休怪我們對他們無義。但是斷交常常只是高層少數人的決定，對大多數平民百姓，特別是北部姆祖祖地區民眾，對我們醫療團都有深厚的感情。但從另一個角度來看，沒有外交的保障，醫療團是否還能持續運作下去？規模可以多大？中國政府是否允許台灣的醫療團繼續在馬拉威工作，都是未知的因素。

我們撤走，病人是最無辜的受害者。聖經說：「愛人不可虛假」。也因此，屏基為了顧念彩虹門診的愛滋病人，撤團以後仍與國際組織合作，以非政府組織的形式繼續派遣人員常駐馬拉威姆祖祖中央醫院以協助彩虹門診的工作。筆者殷切期盼現在兩岸情勢緩和，外交休兵後，醫療衛生援外的經費不會以為不再需要而減少。反倒應該增加，把原來用於兩岸外交競爭的寶貴資源轉用在有意義的醫療衛生人道救援上。

醫療衛生是超越國界的基本人權，也都是台灣引以為傲的強項。台灣要積極走出去，成為別人所尊敬的國家，一個很好的方式就是積極主動協助有需要的國家和地區，提升他們的醫療衛生水準。誠摯希望台灣的國際醫療衛生和人道援助工作可以走出自己的一條路，做一些對世界、對人有價值的事情。同時也要建立制度、培育人才，開拓更多機會讓年輕人參與。我們的心有多大，我們的舞台就有多大。更多台灣人擁有國際的眼光，我們的未來才是寬闊的。

第三章：千禧年發展目標與全球衛生

3.1 千禧年八大發展目標

西元 2000 年 9 月，在聯合國千禧年高峰會議中，就消除世界貧窮、飢餓、疾病、文盲、環境惡化及婦女歧視等重要議題，討論出八個核心發展目標，統稱為「聯合國千禧年發展目標」(UN Millennium Development Goals, MDG)。而且希望聯合國所有會員國，在西元 2015 年之前，要動員政府及民間力量，實現以下發展目標：

1. Eradicate extreme poverty and hunger 消滅極端貧窮及飢餓
2. Achieve universal primary education 普及小學教育
3. Promote gender equality and empower women 促進兩性平等，並賦予婦女權力
4. Reduce child mortality 降低兒童死亡率
5. Improve maternal health 改善產婦保健
6. Combat HIV/AIDS, Malaria and other diseases 迎戰愛滋病毒、瘧疾、及其他疾病
7. Ensure environmental sustainability 確保環境的永續維護
8. Develop a global partnership for development 全球合作促進發展

3.2 千禧年發展目標中的三項衛生目標

其中的第 4-6 項為衛生健康議題，跟本論文有關。在每項發展目標下面，都各有幾項評估指標。

3.2.1 千禧年發展目標的第四項：降低孩童死亡率

在 2015 年前，希望讓五歲以下孩童死亡率降低三分之二，三項評估指標為[6]

13.Under-five mortality rate 五歲以下孩童死亡率

14.Infant mortality rate 嬰兒死亡率

15.Proportion of one-year-old children immunized against measles

一歲孩童接種麻疹疫苗的比例

3.2.2 千禧年發展目標的第五項：促進母親健康

在 2015 年前，希望可以讓母親死亡率降低四分之三。兩項評估指標為[6]

16.Maternal mortality ratio 產婦死亡率

17.Proportion of births attended by skilled health personnel

讓有技能的健康工作者接生的生產比例

3.2.3 千禧年發展目標的第六項：對抗愛滋病、瘧疾和其他疾病

在 2015 年前，希望可以遏止並開始扭轉愛滋病的蔓延趨勢。有三項評估指標為[6]

18. HIV prevalence among pregnant women aged 15-24 years

15-24 歲懷孕產婦的愛滋病盛行率

19. Condom use rate of the contraceptive prevalence rate

避孕措施中的保險套使用率

20. Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years 10-14 歲孤兒對比非孤兒的就學比例

3.3 千禧年衛生發展目標的實現

3.3.1 目前千禧年衛生發展目標的進展

全球希望在 2015 年前達到千禧年發展目標，現在(2010 年)已經過了一半的時間，但是距離完成的目標還很遙遠。根據 WHO 2008 年資料，只有極少數發展中國家能夠朝向千禧年發展目標前進。在 68 個重點國家的孕產婦死亡占全球的

98%，但是其中 56 個國家的孕產婦死亡率仍然很高（超過每 10 萬活產 300 例）[7]。目前全球的孕產婦死亡率是每 10 萬活產 400 例，而 1990 年是 430 例，平均年遞減率少於 1%，遠低於實現千禧年第五個發展目標所要求的年遞減率 5.5%。在許多發展中國家，特別在撒哈拉沙漠以南的非洲和一些亞洲國家，因為缺少足夠的醫療專業人員，嬰幼兒和孕產婦死亡率仍舊偏高[8, 9]。在馬拉威，由於人才外流，醫療人員嚴重不足，產婦和嬰幼兒死亡率亦居高不下[10, 11]。

3.3.2 實現千禧年衛生發展目標的瓶頸

千禧年第五項發展目標(MDG 5)的一個評估指標就是有多少生產是由有技能的 SBA 所接生[6]。這個指標要成功的先決條件是要有足夠的 SBA 數量。

根據國際組織 Safe Motherhood Initiative 的定義，Skilled Birth Attendants (SBA) 僅為下列四種專業人員：助產士(midwives)、護理人員受過助產士訓練(nurses with midwifery skills)、醫師受過助產士訓練(doctors with midwifery skills)和婦產科醫師(obstetricians) [12]。依據上述 SBA 的定義，馬拉威婦女生產由 SBA 接生的比例，在 1995 年為 50%，2006 年也只有 54%。其中都市地區稍為好一點可以達到 84%，但在鄉村地區則只有 53%[2]。

在很多發展中國家實現千禧年衛生發展目標的最大困難就是專業醫護人員缺乏[6]。在這些醫療資源不足地區，要找到所謂的 SBA 到偏遠地區工作非常困難。有時就算能找到人，也可能因為設施不足和交通問題，很難保證產婦可以得到適切的服務[13]，這就是醫療可近性的問題。

3.3.3 解決人力匱乏的替代方案

回顧歷史發現，馬拉威從 1982 年起，有一個全國性的 TBA 訓練計畫，有超過 800 位 TBA 接受訓練並登記註冊[14]。但自從 20 世紀初，因為 Safe Motherhood Initiative 對 SBA 的嚴格定義，認為只有 SBA 才有資格接生，並且貶抑 TBA 的角色與功能，造成全球衛生開始撤走給予 TBA 的資源。以致於從前那些受訓過的

TBA，得不到後續的教育和支持，逐漸被忽略[15-17]。

面對發展落後國家嚴重的醫療專業人員缺乏，過於嚴格定義 SBA，完全忽略 TBA 似乎無濟於事，也無法降低過高的產婦死亡率。雖然 TBA 在過去十年，接受的資源越來越少。但還是有一些研究指出給予 TBA 訓練對於一些發展中國家的婦幼衛生會有正面的幫助[18, 19]：例如產婦知識的進步、產檢率的增加、態度和行為會比較正確、甚至能降低嬰幼兒死亡率[20-23]。

時至今日，已經過了千禧年預訂目標期限的一半，開始有人反省過去一段時間忽略 TBA 是否正確？有人認為應該重新檢視 TBA 的價值，給他們足夠的訓練、支援和監督，他們也可以成為有技能的人力資源[24]。在 2005 年 WHO 出版的文件 Task shifting[25]，就有一個建議可以快速增加 SBA 的人數：**把具有潛力能幹的 TBA 訓練成(transforming)有技能的 SBA**，前提當然要給他們足夠的訓練和密切的監督。

第四章：傳統接生婆訓練計畫與接生婆受訓後的表現

4.1 傳統接生婆訓練計劃

4.1.1 傳統接生婆訓練計劃緣起

為了協助馬拉威的公共衛生，我們必需正視醫療人力匱乏的窘境。我們想到應該可以來訓練這些存在於各地村落，草根性強，本來就已經在接生的 TBA，幫助他們成為有能力的接生人員，因而產生本計劃。

傳統接生婆訓練計劃是由台灣衛生署支持經費，由台灣醫療團執行。計畫實施前，我們先與馬國衛生部商討並獲得衛生部同意，在姆祖祖市開始傳統接生婆訓練，首期開業式並請到衛生部護理司司長 Dr. Phoya 來主持開訓。

4.1.2 傳統接生婆的招訓對象與基本資料

自 2004-2006 年醫療團共開辦三期傳統接生婆訓練，分別是 2004 年 23 位、2005 年 34 位、2006 年 24 位，總共訓練 81 位 TBA。他們的平均年齡為 53.8±10.2 歲，27%未曾上過學校，只有 19%完成小學訓練。這些受訓 TBA 的基本資料如年齡、受教育年數、距離上次訓練或再教育的時間和測驗成績都整理在 Table 2-1。

一般 TBA 並沒有接受正規訓練，許多是偶然間幫鄰居或家中婦女生產，久而久之便成 TBA。醫療團在 Mzuzu 市周圍村落，原則上一個村落找一位 TBA(one village, one TBA)，透過地方領袖的幫忙，來確認各地的接生婆。

4.1.3 傳統接生婆訓練內容

他們來到姆祖祖中央醫院接受四個星期的密集訓練。我們安排中央醫院資深助產士給予他們完整的訓練課程：如瞭解正確的生產知識、熟悉接生技能、辨認危險徵兆以便及時後送。我們希望透過訓練及再教育、督導和裝備接生婆的技能，可以降低一些不必要的母親和嬰兒死亡率[26]。

在馬拉威為了避免不良的處置，TBA 不被允許接生第一胎或是複雜危險的妊

娠。在他們的訓練過程中，我們特別強調危險產程的發現和早期轉診。由於 TBA 識字率低，我們用圖畫來作為轉診單的設計，讓危險徵兆淺顯易懂。

4.1.4 傳統接生婆受訓後的裝備與定期訪視

TBA 受訓後，經過考核，我們會給他們產包，內含生產所需的器械、消耗性衛材、磅秤等裝備，還有一輛腳踏車[4]。此外，醫療團至少每三個月一次會定期訪視督導他們，並給予必要的後勤支援。

在定期訪視中，我們發現訓練過的 TBA 比較有自信，更能夠教導產婦個人衛生、如何照顧新生嬰孩和家庭計畫。村中婦女也會對受訓過的 TBA 有更多的信心，更願意讓這些 TBA 接生。這些發現和其他文獻結果相似，TBA 訓練可以增加產檢的比例並有助於降低母親和嬰幼兒死亡率[21]。

4.2 評估馬拉威產婦到醫療院所的可近性

馬拉威一般人民醫療可近性的兩個主要障礙是醫療專業人員嚴重不足，加上設施缺乏和設備不夠[11, 27, 28]。

4.2.1 用問卷了解產婦抵達醫療院所的交通費用和時間

為了瞭解懷孕婦女到醫療院所的可近性，我們在姆祖祖市地區所有的醫療院所和衛生站，隨機進行問卷調查。

總共有 1138 懷孕婦女接受調查，他們的平均年齡為 24.7±2.3 歲。這些孕婦自述他們到達醫療院所所需的交通時間和費用整理在 Table 1-1。大約有四分之三的產婦花不到一元美金，因為他們大部分都是用走的抵達。有超過一半以上的婦女需要兩個小時以上才能抵達最近的醫療院所。

4.2.2 馬拉威產婦選擇產檢和生產地點的因素

這些產婦對於產檢和生產地點的選擇，我們整理在 Table 1-2。對於正在懷孕的這一胎，大部分的產婦表示會到醫療院所做產檢(79.7%)和生產(81.8%)。但是如

果問她上一胎在那裡生產，不到一半(49.7%%)在醫療院所生產，有三成在 TBA 家生產，也有少部分(3.6%)在自己家裡生產。

產婦選擇地點的主要理由整理在 Table 1-3，其中選擇到醫療院所的主要原因是“Reliable skill and experience(技術和經驗可信賴)”和“adequate facility(設備較好)”，而選擇到 TBA 的主要原因則是“Near-by my house(距離較近)”。在上一胎的生產地點選擇中，選擇在 TBA 生產的產婦中，有 38.7%是因為“Reliable skill and experience(技術和經驗可信賴)”。可見，TBA 的技能也能夠被產婦所接受。

如果考量轉診費用，從 TBA 轉診產婦到醫療院所的費用範圍從美金$0.40 到 $40.00，平均達 US $11.70 (見 Table 1-4)。範圍差距很大跟交通工具有很大的關係。可能是因為轉診通常發生在緊急情況，需要在短時間運用適當的交通工具，所以會產生較高的費用。

4.2.3 用 GPS 和 Google Earth 評估產婦的醫療可近性

為了進一步客觀評估醫療可近性，我們嘗試使用地理資訊科技如全球衛星定位系統 global positioning system (GPS)和 Google Earth 來測量 TBA 到最近的醫療院所的路徑、距離和時間。

從文獻中發現已經有許多研究提到 GPS 在衛生領域的應用，諸如到衛生機構的距離和路程[29-35]和傳染病的防治[36, 37]。另一個工具 Google Earth 也是大家常用的網路工具，可以讓我們從網路上看到世界各地。有人使用 Google Earth 繪製社區地圖，追蹤小兒麻痺病毒的流竄[38-41]。最近幾年有人結合 GPS 和 Google Earth 兩者，進行登革熱的偵測系統和病媒傳染病的控制，來幫助公共衛生的計畫和落實[42, 43]。

所以我們用 GPS 共定位出五間醫療院所和 79 位 TBA 的家(在 2007 年七-八月調查期間，有兩位 TBA 不在家)，將他們的位置顯示在 Google Earth 的地圖上，如 Figure 1。

我們測量記錄從 TBA 到最近的醫療院所需要的時間和距離，整理在 Table

1-4。結果發現由 GPS 所客觀測量的時間和由 TBA 所主觀報告的時間，兩者有很好的相關性 (correlation coefficient 0.654, $P < 0.001$)。表示 GPS 的客觀測量可以真實反應 TBA 實際上的主觀感受。

4.3 傳統接生婆受訓後的成果

4.3.1 傳統接生婆的轉診率和產婦死亡率

從 2004 七月到 2007 六月，總共有 1,984 位懷孕婦女到我們訓練的 TBAs，其中有 170 (8.6%)位產婦被轉到最近的醫療院所：79 (4.0%)是在生產前轉診，91 (4.6%)是在生產後才轉走，見 Table 2-2。

TBAs 所服務的產婦沒有人死亡，可能和高的轉診率(8.6%)有關。表示 TBA 能充分發揮篩檢的功能，早期轉診危險妊娠以降低死亡率，這樣的結果和之前的文獻論點一致[44-46]。

4.3.2 傳統接生婆接生嬰孩的死亡率

扣掉在生產前就被轉走的 79 位婦女，總共有 1,905 個嬰孩由 TBA 接生。其中有 26 個嬰孩死亡，週產期死亡率為每千位活產數有 13.6 個死亡。這 26 個死亡的嬰兒由 17 位 TBA 接生，他們的平均測驗成績顯著低於其他 TBA ($p = 0.004$)，見 Table 2-3。由此推測生產知識的成績可能和嬰幼兒死亡率有相關。但是另一方面，這些有嬰兒死亡的 TBA，他們接生數也較多。因此也有可能是因為他們的生產數較多，有較高的機會遇到較困難的個案。

2004 年馬拉威全國性調查，北部地區嬰孩的死亡率是每千位活產數有 40 個嬰兒死亡[47]，2007 年 WHO 的統計則是每千位活產數有 26 個死亡[2]。對照馬國全國的統計資料，這些經過我們訓練和督導的 TBA，他們所接生的 1905 位嬰孩，嬰兒死亡率(每千位活產數有 13.6 個)，不到全國統計值的一半。這樣的結果再一次證明 TBA 是可以協助降低嬰幼兒死亡率的[19, 23]。

4.4 持續教育對傳統接生婆知識的重要性與影響因素

除了初始的訓練外，對 TBA 持續教育的重要性似乎未曾被探討，特別是他們識字率很低，持續教育應該如何進行？我們也需要更多證據來了解 TBA 訓練和再教育的效果，希望能夠幫助全球衛生界重新定位 TBA 的角色和給予適當的支持。

我們發現持續教育對接生婆關於生產的知識密切相關(Figure 2)。剛受訓完時，答對的比例最高。隔一段時間例如半年後，答對的比例會降低；給予他們再教育課程後，答對的比例又回升，然後會隨著時間再逐步降低。

近一步用 GEE model[48]來統計分析 TBA 成績高低的影響因素發現，TBA 年齡較低(少於 45 歲)、受教育年數較多(小學教育超過 5 年)、較多次的測驗和較短的考試間隔時間(少於一年)都有助於提高分數，如 Table 2-4。因此我們認為持續再教育對於 TBA 知識的維持和生產結果非常重要，至少每年一次要舉辦一次。

另外，TBA 的個人特質也扮演重要的角色。原則上較為年輕(年齡少於 45 歲)、受教育年數較多(多於 5 年的基本教育)比較能夠被訓練成有能力的接生人員。反之，對於年紀較大，受教育年數較短的 TBA，就應該給予更多的督導和教育。我們的結果支持過去文獻的論點，如果這些 TBA 沒有被適當的督導和持續性的支持，他們很有可能回到原來的習慣和方式[49]。

4.5 傳統接生婆能扮演的角色

統計指出全非洲只有 47%的接生是由所謂的 SBA 接生[50]，換句話說，還有一半的懷孕生產仍由未經訓練的接生婆或親屬幫忙，可見接生婆在非洲國家仍扮演著不可或缺的角色[50]。

TBA 居住在鄉村村落，熟悉當地文化習俗，被村落人民所認識，常常是最靠近孕產婦的諮詢人員和幫助者。TBA 可以是產婦和專業 SBA 人員之間的橋樑[16]，例如 TBA 可以增加產婦接受產檢的比率。在南非，大部份的助產士都認同 TBA 的功能，認為應該把他們整合到主流的醫療體系中[51]。

我們認為在資源不足，缺乏醫療專業人員地區，整合 TBA 到主流的醫療體系可以是改善婦幼衛生最經濟有效的策略[52]。當然我們不可以忘記要給予他們適當的訓練與每年至少一次的持續再教育。

2006 年我陪同馬國衛生部長 Dr. Hetherwick Ntaba 在日內瓦參加世界衛生大會時，跟他提到醫療團 TBA 訓練計劃的初步成果，他非常驚喜，馬上說他也是 TBA 所接生的小孩，並且主動在會議上呼籲 WHO 和其他相關組織不應忽略 TBA 在落後國家所能扮演的角色。

世界衛生組織呼籲「**珍惜每一個母親與孩童**，Make Every Mother and Child Count」，我們也相信**救一個母親就是救一個家庭，救了家庭就是救了國家**。我們不應放棄任何可用的資源，包括像 TBA 這種有潛力的人力資源。我們希望我們 TBA 訓練計劃的研究成果能為落後國家的婦幼衛生，在專業人力匱乏的困境中找到一條出路。提醒全球衛生界重新定位 TBA 的角色與功能，再次給予他們足夠的訓練資源和後勤支持，並把他們納入醫療體系。也惟有這樣，千禧年第五項衛生發展目標才有機會在 2015 年前圓滿達成。

第五章：愛滋病人接受治療的存活分析

5.1 馬拉威愛滋病流行現況

撒哈拉沙漠以南的非洲是愛滋病最盛行的地方。馬拉威 15-49 歲成人中愛滋病感染率為 11.9%，全國一千 3 百萬人口中，估計有 930000 人感染愛滋病，其中約 200000 人需要 ART 治療[1]。

很多社會青壯人口死於愛滋病，留下老年人要撫養年幼的孩童，社會生產力下降，依賴人口比例升高，造成國家經濟發展停滯甚至倒退。每年因為愛滋病新增加約 10000 名孤兒。這些孤兒面臨許多艱困的挑戰，例如失去雙親的心理衝擊、失去就學的機會、在社會上被貼標籤或被歧視、營養不良、死亡率增加...等。

許多愛滋病人因為沒有藥物治療或是付不出錢看病，沒有醫療、沒有照顧，也就沒有希望。許多患者因而自暴自棄。許多潛在的感染者因為檢驗後也沒有治療，就乾脆放棄檢驗。因為知道結果又如何？

5.2 醫療團愛滋病彩虹門診

5.2.1 愛滋病彩虹門診

所幸世界衛生組織成立全球基金(Global Fund)，供應許多貧窮國家免費的愛滋病藥物，馬拉威是其中之一。醫療團為協助馬拉威對抗愛滋病，從 2004 年 7 月 1 日起開辦馬國北部第一個愛滋病免費治療門診，命名為「**彩虹門診(Rainbow Clinic)**」，含意取自聖經中上帝與人立約，設立彩虹作為記號。彩虹代表上帝永遠不忘記人，也代表我們不應遺忘這群愛滋病人。愛滋病藥物費用由全球基金支持，藥品由聯合國兒童基金會(UNICEF)派駐馬拉威的人員負責採購和發放到馬拉威全國的治療站[4]。

5.2.2 指紋辨識系統

由於馬拉威沒有身分證，為了正確辨識病人和有效管理愛滋病治療藥物(antiretroviral therapy, ART)，醫療團研發出「**愛滋病人指紋辨識資訊系統(簡稱彩虹系統)**」，以登錄病人臨床過程和用藥情形。所有接受愛滋病藥物的病人資料，包括年齡、性別、初始身高體重、開始 ART 治療的時間和理由以及 WHO 臨床分級、治療結果、遵醫囑性與服藥遵從性等資料都進入這套電子資訊系統。我們比較彩虹系統使用前後的結果，證明能大幅節省門診所需的人力與時間，並增進服務品質，研究結果 2005 年獲刊於 Lancet[5]。這也是台灣駐馬拉威醫療團發表在國際知名學術期刊的第一篇論文。

5.2.3 愛滋病個案之收案評估與諮詢

所有 HIV 感染者，被轉介到彩虹門診都要進行完整的臨床和免疫學檢查以及營養評估。家屬也要接受治療前的諮詢和教育，以確定他們知道如何協助照顧病人。治療的原則都遵照馬國衛生部制定的準則[53, 54]。

5.2.4 愛滋病治療過程與結果

開始治療第一個月，患者每兩週回診一次，然後每個月回來複診拿藥。我們會登錄病人在進入治療前、第一個月回診時和以後每三個月的體重和身高。

治療結果分為 (a)存活並繼續在彩虹門診接受 ART；(b)死亡；(c)失去追蹤超過三個月；(d)轉到其他 ART 治療站。

5.3 成人愛滋病人接受治療的存活分析

5.3.1 成人愛滋病人收案時間與個案數

在 2004 年 7 月到 2006 年 12 月間，彩虹門診總共有 4001 位愛滋病人。扣掉 473 位小於 15 歲的兒童和 690 位轉到其他醫院的病人，共有 2838 位接受 ART 治療。

5.3.2 成人愛滋病人存活率與相關危險因子分析

臨床追蹤這群病人到 2006 年 12 月底，還有 2029 (71.5%)存活繼續接受 ART 治療，376 (13.2%)死亡，433 (15.3%)位失去追蹤或停止治療，見 Table 3-1。分析發現病人的存活率隨著 WHO 臨床嚴重度增加而降低。WHO 臨床第 1&2 級的病人，存活率為 85.0%；臨床第三級為 72.1%；臨床第四級則為 60.1%。相反的，病人如有較高的 BMI，存活率會較高，見 Table 3-1。

在 2838 位的愛滋病成人中，女性比男性有較高的存活率(76.0% vs. 64.6%; $P < 0.001$ in Table 3-1)。進一步作 Kaplan-Meier 存活分析發現，在 WHO 臨床分級 1-3 級，女性病人存活率顯著優於男性($P < 0.0001$)，但在 WHO 臨床第四級，則只有些微差異($P = 0.076$)，見 Figure 3。

進一步用多變項 Cox proportional hazard model 分析發現：男性、年齡較低、BMI 較低、WHO 臨床嚴重度高的病人有較高的死亡危險，見 Table 3-2。

5.3.3 成人愛滋病人治療結果之性別差異

許多文獻指出男性愛滋病人有較高的死亡率[55-61]，但其中有些研究並未達到統計顯著差異，可能跟樣本數太少或追蹤時間太短有關[62]，有些則是沒有控制其他變因，如 WHO 臨床分級和營養狀況。本研究追蹤時間長達 30 個月，用統計分析控制其他變因，發現男性仍為死亡重要的相關原因。

在彩虹門診，女性病人本來就比男性病人多(60.5% vs. 39.5%)。這可從下列因素解釋：首先，有較多的女性願意接受愛滋病的諮詢和檢驗[63]，可能因為女性是主要的兒童照顧者，有較高的動機進行愛滋病的諮詢和檢驗。相反的，男性可能因為面子問題，遲遲不願意接受愛滋病的諮詢、檢驗和治療。我們也發現，男性通常在 WHO 臨床嚴重度較高的時候才來就診，死亡率自然會較高。再加上男性遵醫囑性較差，失去追蹤比例較高(18.6%，Table 3-1)，以致於繼續接受治療的人數較低。

如果按照職業來看，不管是高社經地位的行業(如商業)或低社經地位(如農

人)，男性的存活率都比較差。男女的存活率差異存在於各行各業，表示這是一個社會各階層共通的現象。此外擁有職業的病人，比較不會失去追蹤。因此對於沒有固定職業的人，要多加注意，因為失去追蹤的比例較高。

5.3.4 結論

本文發現在接受愛滋病治療的成人中，男性的存活率比女性差，達統計顯著，這可能和**男性較晚被診斷、接受治療時的臨床嚴重度較高、較高比率失去追蹤和較差的遵醫囑性有關**。這點提醒我們在推廣愛滋病藥物治療時，應注意性別差異可能帶來的影響。

因此，為了改善存活率，鼓勵病人早點接受治療，改善病人的遵醫囑性，特別是男性病人，應該是我們推廣愛滋病治療時候要注意的課題。

5.4 兒童愛滋病人接受治療的存活分析

5.4.1 兒童愛滋病人收案時間與個案數

在 2004 年 9 月到 2006 年 12 月之間，共有 505 位開始治療時年齡小於 15 歲的兒童接受愛滋病 ART 治療。其中的 263 (52.1%)是男生。他們的基本資料按照 BMI 分成四級，整理在 Table 4-1。我們發現 WHO 臨床嚴重度較高的病童，有較高的比例他們的 BMI 會小於 13，存活的孩童也比死亡的孩童會有較高的 BMI。

5.4.2 兒童愛滋病人與相關危險因子分析

我們追蹤到這群病人到 2009 年 8 月底，總共有 82 位(16.2%)死亡，其中 64 (78.0%)位死於治療開始後的六個月內；69 (84.1%)位死於治療開始後的一年內；80 (97.6%)位死於治療開始後的二年內。兩年之後，只有兩位死亡。

我們進一步用 Cox proportional hazard model 統計分析，發現 BMI $\leqq$15 kg/m^2 和 WHO 臨床第四級是兩個顯著的危險因子，都有約三倍高的死亡機會(表 Table 4-4)。病童的 BMI 增加和 WHO 臨床嚴重度低都會增加存活率，這和之前的文獻

結果一致[64-68]。年齡越大，死亡危險性越低，而性別和是否為孤兒則不是危險因子。進一步以 BMI 大於或小於 15 kg/m^2 作分層，用 Kaplan-Meier 存活分析發現，如果 BMI ≦15 kg/m^2，WHO 臨床第四級的病童存活率顯著低於臨床第 1-3 級；但如果 BMI >15 kg/m^2，臨床第四級的病童和臨床第 1-3 級的存活率就沒有差別，見 Figure 4。這表示營養不良(BMI ≦15 kg/m^2)可能是臨床嚴重病童(WHO 臨床第四級)會不會死亡的重要先決條件。

5.4.3 愛滋病童接受治療後營養狀況改善

我們追蹤孩童在治療初期與隨後回診時後的身高、體重，發現 ART 可以迅速改善病童的 BMI 營養狀況(Table 4-2)，這和之前的研究結果一致[65, 69]。

那些最終死亡的病童，在剛開始治療時候的 BMI 顯著較低，但隨著治療時間，他們的 BMI 會快速增加，到第三個月就和存活的病童差不多。同樣情形也發現在 WHO 的臨床分級。臨床嚴重度高的第四級病童，在剛開始治療時候的 BMI 顯著較低，但隨著治療時間，他們的 BMI 也會快速增加，到第三個月也就和臨床嚴重度較低的 1-3 級差不多，見 Table 4-2。

營養不良對於死亡的影響會隨著 ART 治療時間而遞減，到第三個月後營養不良在存活與死亡兩組間的差異就消失。六個月以後的死亡原因可能就要歸到其他原因，如伺機性感染、肺結核病等。這個假說在 Receiver Operating Characteristic Analysis (ROC 分析)中進一步得到驗證(見 Table 4-3)。所以我們建議 ART 開始治療的前三個月，是營養評估和介入的黃金時間，特別是對那些營養狀況不理想的病童。

5.4.4 BMI 和其他營養指標對治療結果的預測比較

我們用 ROC 統計分析和 area under the curve (AUC)比較身高、體重、重高比(weight-for-height)、BMI 和 WHO 臨床分級對於預後的預測能力，結果整理在 Table 4-3。結果發現 BMI 和重高比在一開始和第一個月的 AUC 都比 WHO 臨床分級還

高，顯示這兩個指標都比 WHO 臨床分級有更好的預測能力。

在馬拉威，大部分的孩童和照顧者都不清楚小孩的確切生日，無法知道確實年齡，也因此實際上要使用 weight-for-age 或 height-for-age 會有困難，BMI 和 weight-for-height 就比較沒有年齡的干擾問題。從我們的 ROC 分析中發現 BMI 又比 weight-for-height 更理想，因為 BMI 的 AUC 比 weight-for-height 大，表示有更好的預測力(Table 4-3)。

5.4.5 瀕臨死亡的營養不良關鍵閥值

BMI 已經成為許多醫療資源不足地區愛滋病人預後的重要指標[70]。在成人愛滋病人，發現 BMI 小於 16 或 17 是顯著的危險因子[66, 68, 71]。但兒童的 BMI 一般小於成人[72]，在本研究中的孩童就有超過三分之二的兒童(69.3%)，他們的 BMI 小於 16。所以拿 16 或 17 作為兒童 BMI 的閥值並不適當。

我們從 ROC 分析中發現兩個顯著的 BMI 數值，分別是開始接受治療時的 14.7 kg/m^2 和第一個月回診的 15.3 kg/m^2 (Table 4-3)。我們取這兩個數值中間的整數 15 作為閥值(threshold)，並在隨後的 Cox proportional hazard model 驗證 BMI <15 kg/m^2 是顯著的危險因子(Table 4-4)。本研究可能是第一篇訂出兒童營養不良以致於會瀕臨死亡的關鍵閥值：BMI <15 kg/m^2。

5.4.6 性別和是否為孤兒對存活率沒有影響

不同於成人愛滋病人的結果，性別在愛滋病孩童的存活率沒有造成差別，這可能和男女病童的家長或照顧者的遵醫囑性差不多有關。病童是否為孤兒，存活率也沒有顯著差異，表示在馬拉威和許多非洲國家的家庭制度[73]，還能夠協助孤兒得到適當的照顧和就醫治療。我們希望愛滋病童和其照顧家庭可以得到適切的社會與經濟支持，使他們可以維持良好的遵醫囑性和營養補充[74]。

5.4.7 結論

在這群 505 位愛滋病童，他們接受 ART 治療的五年存活率達到 67.7%。我們

發現 ART 不僅可以增加愛滋病童的存活率，也能改善他們的營養狀況。BMI 比 WHO 臨床分級對預後有更好的預測能力，一開始的 BMI 若小於 15 kg/m^2，會有三倍高的死亡機率。嚴重營養不良是兒童愛滋病死亡的重要原因，其影響主要在早期階段，特別是剛開始治療的前三個月內，所以營養的評估和介入要越早越好。營養不良的評估與介入應該整合在愛滋病童的 ART 治療計畫中。

第六章：整合愛滋病防治與婦幼衛生

6.1 預防愛滋病母子垂直感染(PMTCT)

ART 提供愛滋病人一線生機與希望，讓他們有機會延長生命，回到工作崗位，回到學校就學。但是愛滋病截至目前並無法治癒，只能終身倚賴藥物壓制病毒對身體的危害。終身長期的愛滋病藥物需要龐大的費用，讓免費供應 ART 的 Global Fund(全球基金)感到吃不消。加上近年金融海嘯和經濟不景氣，全球基金捐款減少，免費的愛滋病藥物也有即將斷炊之虞。

因此「預防重於治療」在愛滋病的防治上就顯得更為實際而重要，如果能減少一位愛滋病新感染者，就能減少以後龐大的醫療花費。而經由母親垂直感染嬰孩，是愛滋病散播的重要途徑。在 2008 年，全球估計有 43 萬個小孩新感染 HIV，其中超過 90%是經由母子垂直感染。如果沒有治療，其中一半的小孩會在兩歲以前過世[75]。如果沒有預防母子垂直感染(Prevention of maternal to child transmission ，PMTCT)，母子垂直感染的危險性約 20%到 45%；如果有 PMTCT，在非母乳哺育的小孩，母子垂直感染的危險性可以降到小於 2%；在母乳哺育的小孩，母子垂直感染的危險性也會小於 5%[75]。由此可見 PMTCT 在防治愛滋病的重要性。

根據 2010 年 2 月 WHO 出版的 PMTCT strategic vision 2010–2015，WHO 所要推廣的完整 PMTCT 包含下列四項作法[75]：

一、預防生育年齡婦女感染 HIV；

二、預防已感染 HIV 的婦女無意中懷孕；

三、預防已感染 HIV 的婦女將 HIV 病毒傳染給她的小孩；

四、提供已感染 HIV 的婦女、她的小孩和家人適當的治療、照顧和支持。

PMTCT 希望能讓婦女與小孩免於 HIV 的感染。最終目的要根除孩童感染 HIV，促進已感染的母親、新生兒和孩童的存活機會。PMTCT 是預防愛滋病傳播

的重要策略，PMTCT 的成功也是我們能否達成千禧年第六項目標的關鍵策略。

6.2 訓練 TBA 協助 PMTCT

在非洲撒哈拉沙漠以南的國家，護士和助產士是產婦最重要的專業幫助者。有研究指出，如果要目前現有的護士和助產士協助 PMTCT，仍需要給予他們足夠的訓練和薪資待遇，並賦予他們在 AIDS 防治上適當的角色[76]。但是在資源不足國家，通常也是 AIDS 流行地區，推行 PMTCT 最常面臨的困境是專業人力不足。在一個針對七個落後國家的調查指出，若要全面實施 PMTCT，不僅需要投入比目前更多的資源，其中最主要的瓶頸還是醫療人員的不足，而且人員缺乏的問題遠比金錢缺乏還嚴重[77]。

在全球努力設法預防 HIV 母子垂直感染之際，全世界估計每年有超過一百萬感染 HIV 病毒的產婦在生產時得不到專業人員的幫助。這時，具有潛力的 TBA 就又浮上檯面，他們在貧窮的鄉村地區可以成為寶貴的人力資源。他們可以被訓練來協助 HIV 的諮詢和檢驗，在適當的監督下，也可以進行 PMTCT[78]。有一個在馬拉威的研究發現，TBA 可以協助那些已經離開醫院的產婦繼續使用 PMTCT 藥物 Nevirapine。換句話說，TBA 能夠增進產婦對 PMTCT 的治療遵從性 (adherence)[79]。

6.3 總結與應用：整合愛滋病防治與婦幼衛生

千禧年八大目標中的三項衛生目標，歸納起來就是**婦幼衛生**與**愛滋病**，這是全球衛生界目前最重要的課題。距離 2015 年千禧年發展目標的期限，只剩下五年。也許距離目標的完成還有一段距離，但只要努力，策略正確，我們還是可以盡力趨近目標。

在發展中國家，達成千禧年衛生發展目標最主要的瓶頸就是**醫療衛生人力缺乏**。本論文從 TBA 的訓練計劃和他們受訓後的表現，發現 TBA 可以是潛在的人

力資源，前提是要給予好的訓練和持續教育。如果我們能挑選合適的人，例如受過完整小學教育，年齡小於 30 歲的 TBA，給予他們好的訓練和持續教育，將他們訓練成社區衛生工作者(community health worker)，相信可以大幅降低醫療衛生人力缺乏的窘境，減少對專業醫療人力的依賴。例如我們可以在資源缺乏的鄉村設立衛生站，讓這些受訓過的 TBA 或社區衛生工作者主持。他們可以接生、轉介危險妊娠到醫療院所、做衛生教育、進行 PMTCT、給營養不良的孩童補充營養等基本衛生照護[80]。加上專業人員定期的訪視與監督和給他們每年至少一次的教育訓練和充足的後勤支援，相信可以大幅改善落後地區的婦幼衛生與愛滋病防治。如此，千禧年衛生發展目標的實現也就指日可待。

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圖目錄(List of Figures)

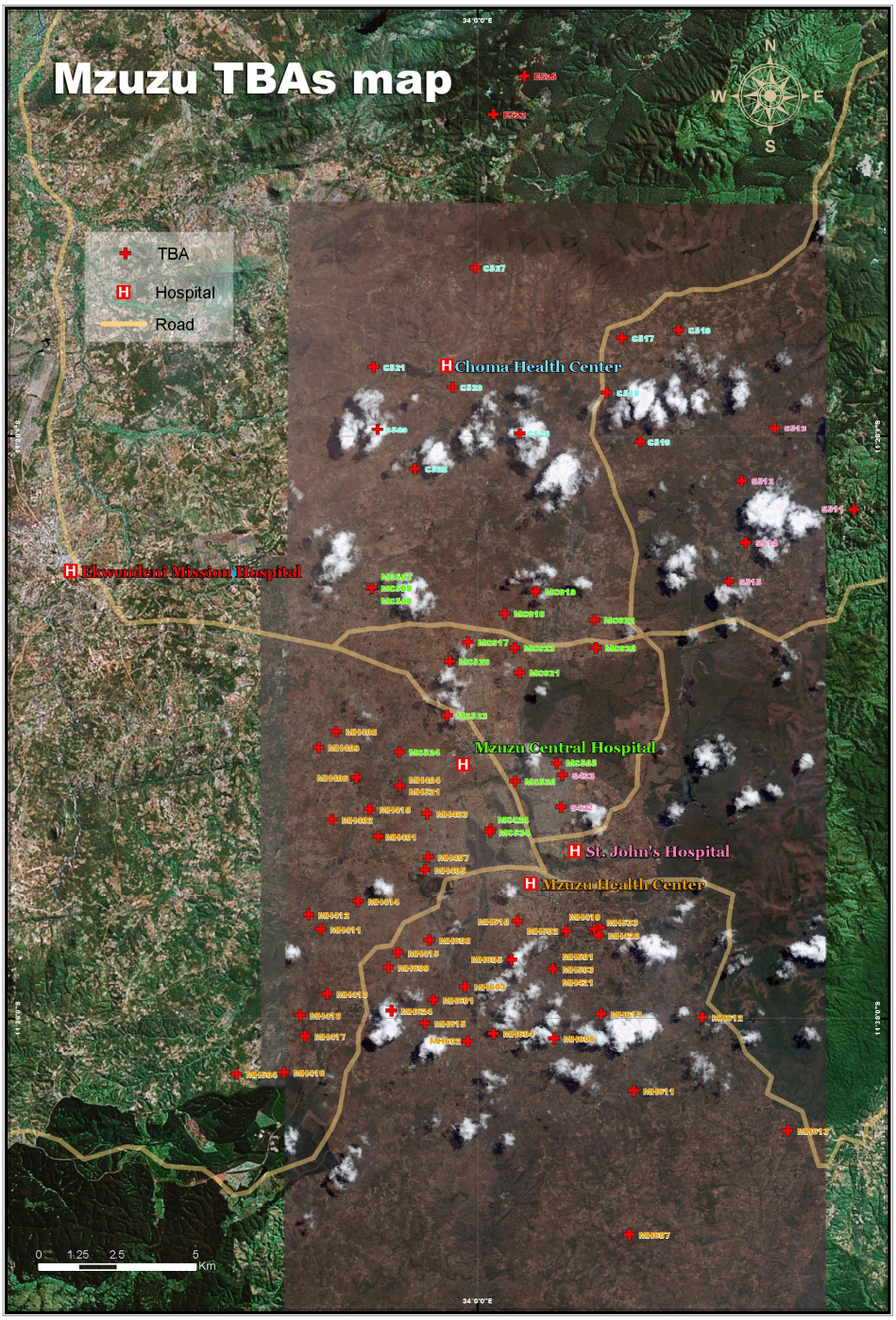

Figure 1. This map, based on a picture taken from Google Earth, shows the locations of five health facilities and homes of 79 TBAs (traditional birth attendants) in Mzuzu city in the northern region of Malawi. The color and identification number of each TBA is related to the health facility where each she refers the pregnant women in her care: C, Choma health center; E, Ekwendeni mission hospital; MC, Mzuzu central hospital; MH, Mzuzu health center; S, Saint Johns' district hospital.

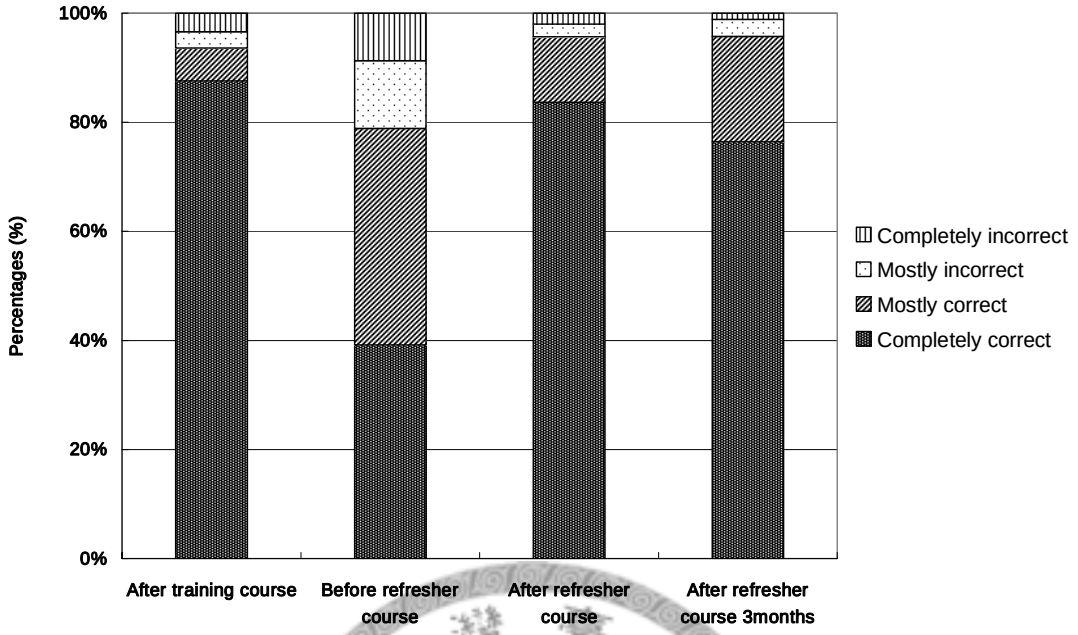

Figure 2. Changes in proportion of correct answers among 25 traditional birth attendants receiving 4 evaluation tests. The point scales for each question ranged from 0 to 3, and the test had 47 questions. The categories for question responses were defined as follows: Completely incorrect = 0 points; Mostly incorrect = 1 point; Mostly correct = 2 points; Completely correct = 3 points. The percentage shown in the figure is the number of responses in each point category divided by the total number of questions administered (47 questions * 25 TBAs = 1175).

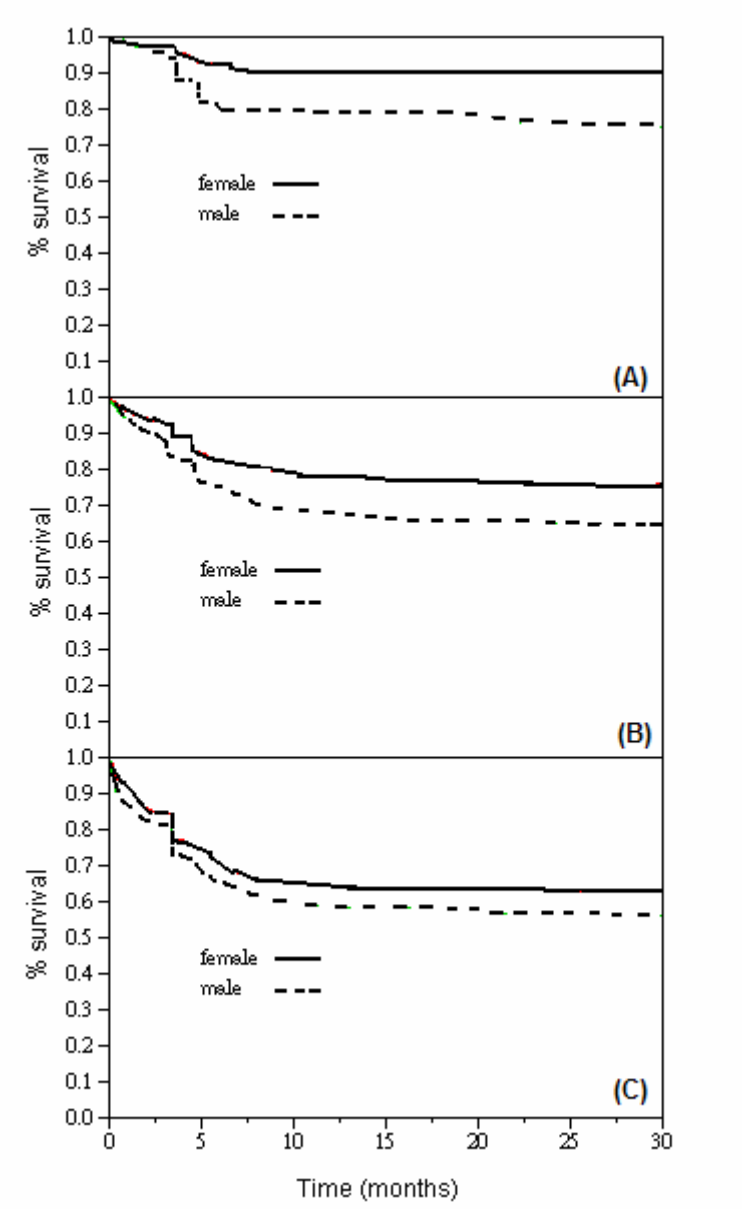

Figure 3. The Kaplan-Meier estimates of the survival rate between males and females stratified by WHO stage 1 and 2 (A), 3 (B) and 4 (C) according to duration of follow-up in 2838 AIDS patients. The log-rank tests revealed statistically significant differences between males and females in WHO stage 1 & 2 (A), and 3 (B) (both *P*'s < 0.0001), but no statistically significant difference between males and females in WHO stage 4 (C) (*P* = 0.076).

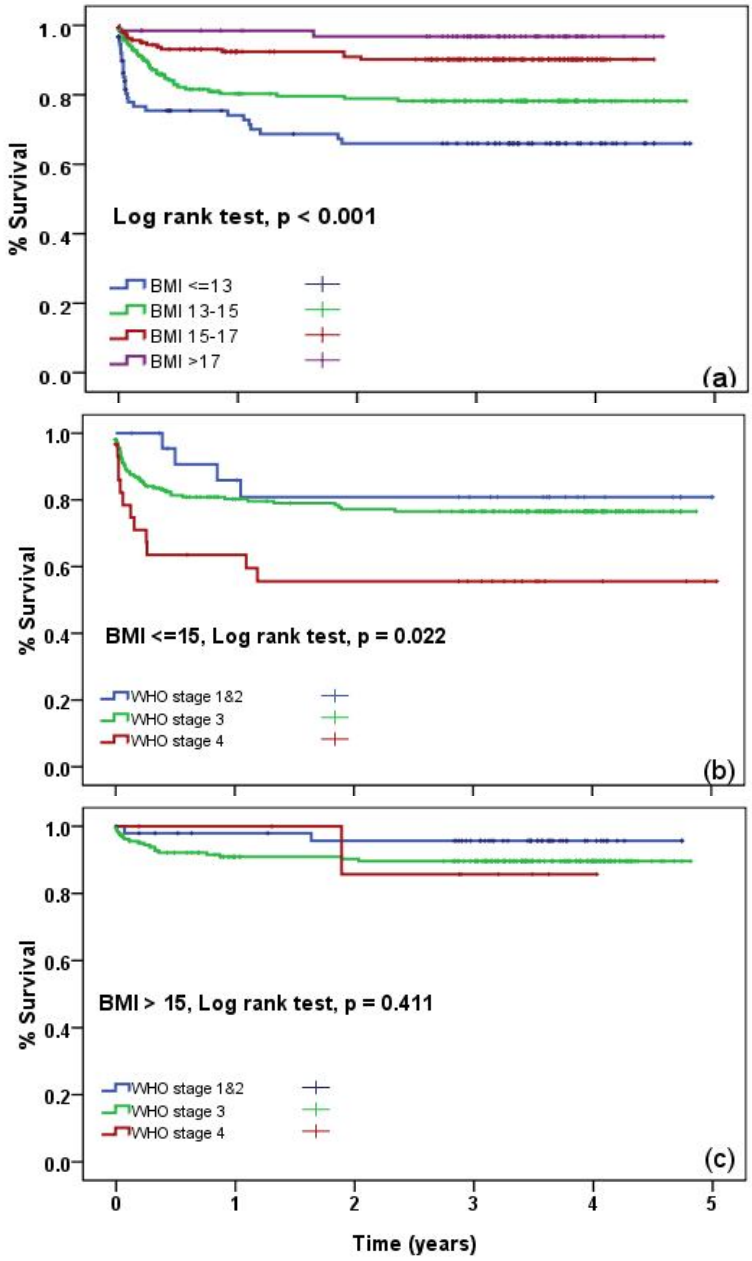

Figure 4. The Kaplan-Meier estimates of the survival rates stratified by 4 categories of body mass index (BMI)(a); the whole data is reclassified into BMI <=15 kg/m^2 (b) and BMI >15 kg/m^2 (c) and compared by Log Rank test for three WHO clinical stages (stages I & II combined, III, and IV) according to 5 years of follow-up in 505 AIDS children.

表目錄(List of Tables)

Table 1-1. Frequency distributions of transportation time and cost required for pregnant women to reach the nearest health facility (n=1138)

Time required	**Number (%)**
< 1h	273 (24.0)
1h-2h	246 (21.6)
2h-3h	197 (17.3)
3h-4h	109 (9.6)
4h-5h	72 (6.3)
>5h	60 (5.3)
Missing	181 (15.9)
Cost required	**Number (%)**
< US$ 1	852 (74.9)
US$ 1-2	242 (21.3)
> US$ 2	28 (2.5)
Missing	16 (1.3)

Table 1-2. Sites for antenatal care, preferred delivery site, and actual delivery site of pregnant women (n=1138).

	Site for antenatal care Number (%)	Preferred delivery site for current pregnancy, Number (%)	Actual delivery site of previous pregnancy, Number (%)
Health facilities	**907 (79.7)**	**940 (82.6)**	**554 (49.7)**
Central hospital	38 (3.3)	107 (9.4)	66 (5.9)
District hospitals	244 (21.5)	515 (45.2)	288 (25.8)
Health Centers	625 (54.9)	310 (27.2)	200 (17.9)
Non-Health facilities	**47 (4.1)**	**191 (16.8)**	**377 (33.8)**
TBA	47 (4.1)	191 (16.8)	336 (30.1)
At home [a]	0 (0)	0 (0)	41 (3.7) [a]
Missing	**184 (16.2)**	**7 (0.6)**	**184 (16.5)[b]**

TBA means traditional birth attendant.

a. 35 of 41 women who delivered babies at home were assisted by TBA, so there were total 371 (32.6%) babies were delivered by TBAs.

b. 23 primigravida who were unable to answer the question of previous delivery sites were excluded.

Table 1-3. Comparison of frequencies between choices of delivery sites at health facilities and TBA for previous and current pregnancies stratified by reasons of preferences among pregnant women (n=1138)

	Delivery site of previous pregnancy			Delivery site of current pregnancy		
	Health facilities	TBA		Health facilities	TBA	
Reason of preference	Number (%)	Number (%)	P value	Number (%)	Number (%)	P value
Reliable skill and experience	248 (44.8)	130 (38.7)	0.072	453 (48.2)	36 (18.8)	< 0.001
Adequate facility	235 (42.5)	101 (30.1)	< 0.001	440 (46.8)	2 (1.0)	< 0.001
Nearby my house	113 (20.5)	166 (49.4)	< 0.001	173 (18.4)	158 (82.7)	< 0.001
Be used to this delivery site	61 (11.0)	27 (8.0)	0.147	68 (7.2)	25 (13.1)	0.007
Someone suggests	8 (1.4)	5 (1.5)	0.96	25 (2.7)	2 (1.0)	0.183
Number of respondents	554	336		940	191	

TBA means traditional birth attendant.

Table 1-4. Distances, time required, and transfer costs estimated by global positioning system (GPS) and traditional birth attendants (TBA) from their homes to the nearest health facilities

Health facility	TBA Number	Distance measured by GPS in kilometers Mean (min. – max.)	Time estimated by GPS in hours [a] Mean (min. – max.)	Time reported by TBA in hours Mean (min. – max.)	Transfer cost estimated by TBA (USD) Mean (min. – max.)
Mzuzu Central Hospital	17	5.7 (3.2 – 8.1)	1.1 (0.6 – 1.6)	1.4 (0.8 – 2.5)	3.4 (2.3 – 5.3)
St. John's Hospital	7	17.3 (3.4 – 24.5)	3.5 (0.7 – 4.9)	2.5 (0.5 – 4.0)	22.9 (4.2 – 40.0)
Ekwendeni Mission Hospital	**2**	**31.4 (30.7 – 32.1)**	**6.3 (6.1 – 6.4)**	**6.0 (5.5 – 6.5)**	16.9 (0.4 – 33.3)
Mzuzu Health Center	43	7.3 (1.9 – 12.4)	1.4 (0.4 – 2.5)	1.6 (0.5 – 4.3)	5.4 (0.4 – 26.7)
Choma Health Center	10	15.2 (0.9 – **51.5**)	3.0 (0.2 – 10.3)	2.5 (0.7 – 5.0)	29.3 (2.7 – **40.0**)
Total	79	10.5 (0.9 – 51.5)	2.1 (0.2 – 10.3)	2.0 (0.5 - 6.5)	11.7 (0.4 – 40.0)

Notes: [a] Time estimated by GPS was calculated from the distance measured by GPS divided by the average speed of walking at 5 kilometer per hour.

Table 2-1. Demographics of traditional birth attendants (TBAs) trained in different calendar year in Mzuzu City in Malawi: number of TBAs for each training year, age, years of education, reproductive health knowledge test scores, and time elapsed since last training course

Trained year	2004	2005	2006	Total
Number of TBAs	23	34	24	81
Age (years, mean ± S.D.)	53.1±8.4	56.4±9.4	48.8±10.8	53.8±10.2
Education (years, mean ± S.D.)	3.5±3.2	4.3±2.8	4.7±3.2	4.1±3.2
Test frequency	1	5	4	
Test time elapsed since last training (months, mean ± S.D.)	1	5.7±5.6	4.2±4.5	4.7±5.1
Test scores (mean ± S.D.)	120.2±13.4	123.0±18.6	126.0±15.3	123.8±17.1

S.D. = standard deviation
The point scales for each question ranged from 0 to 3, and the total score for a test ranged from 0 to 141.

Table 2-2. Referral rates of 1,984 pregnant women and perinatal mortality of 1,905 deliveries for 81 traditional birth attendants (TBAs) from 2004 – 2007, stratified by maternal ages.

Maternal Age	No. women visits (%)	Transfer number			No. Deliveries (%)	Number of perinatal deaths (per 1,000)		
		Before birth	After birth	Subtotal (per 100)*		Before birth	After birth	Subtotal (per 1,000)*
<20 yr	136 (6.9)	14	7	21 (15.4)	122(6.4)	2	1	**3 (24.6)**
20-34 yr	1629 (82.1)	52	69	121 (7.4)	1,577(82.8)	9	10	**19 (12.0)**
>34 yr	201 (10.1)	3	10	13 (6.5)	198(10.4)	1	3	**4 (20.2)**
Unknown	18 (0.9)	10	5	15 (8.8)	8(0.4)	0	0	**0 (0.0)**
Total	**1,984 (100)**	**79 (4.0)**	**91 (4.6)**	**170 (8.6)**	**1,905 (100)**	**12 (6.3)**	**14 (7.3)**	**26 (13.6)**

* The maternal referral rates and perinatal mortality rates were significantly different among three groups of maternal ages ($p < 0.05$ by Poisson distribution test).

Table 2-3. Comparison of demographic characteristics of two groups of traditional birth attendants (TBAs) with and without perinatal mortality, in Mzuzu City in Malawi

Outcomes of deliveries with perinatal mortality	No	Yes	*p* value
No. of TBAs providing services	64	17	
No. of newborn deaths	0	26	
Total number of newborns delivered	1098	807	
No. of newborns delivered per TBA per year (mean ± S.D.)	25.4 ± 3.7	51.8 ± 24.4	0.070
Age of TBAs (years, mean ± S.D.)	53.4 ± 1.3	54.5 ± 2.3	0.695
Years of education of TBAs (mean ± S.D.)	4.3 ± 0.4	3.6 ± 0.7	0.399
Test scores of TBAs (mean ± S.D.)	**133.5 ± 1.2**	**124.5 ± 3.9**	**0.004**

S.D. = standard deviation

Table 2-4. Multivariate modeling of the time elapsed since last education course and the reproductive knowledge test, ages and years of education of TBAs, with their test scores, using the generalized estimating equation (GEE) model.

Variables	Estimate ± S.E.	95% CI	*p* value
Test time elapsed since last training, months			
< 6 months	Reference		
7 ~ 12 month	-0.74 ± 1.96	-4.59 ~ 3.10	0.704
> 12 month	**-26.26 ± 3.22**	**-32.57 ~ -19.96**	**< 0.001**
Age, years			
<= 45 years	Reference		
45 ~ 60 years	**-4.14 ± 1.77**	**-7.61 ~ -0.67**	**0.019**
> 60 years	**-7.14 ± 2.35**	**-11.74 ~ -2.54**	**0.002**
Education, years			
No school	Reference		
Grade 1 – 4	5.62 ± 2.92	-0.11 ~ 11.34	0.054
Grade 5 – 9	**11.19 ± 2.43**	**6.42 ~ 15.96**	**< 0.001**
Test frequency	**2.89 ± 0.67**	**1.58 ~ 4.20**	**< 0.001**
Babies delivered per year	0.09 ± 0.04	0.00 ~ 0.17	0.051

S.E. = Standard error; 95% CI = 95% confidence interval.
GEE model was used to deal with repeated measurement of correlated data.

Table 3-1. Demographic, clinical characteristics, and outcomes of 2838 adult patients infected with HIV who attended and received antiretroviral treatment at Rainbow Clinic of Mzuzu Central Hospital, Malawi

Variables	All subjects	Male	Female	*P*-value
Number (%)	2838	1122 (39.5)	1716 (60.5)	
Age (yrs) at diagnosis	38.6±9.8	41.2±10.0	36.9±9.3	<.0001
Outcomes at end of period of observation: Number (%)				
Alive on ART	2029 (71.5)	725 (64.6)	1304 (76.0)	<.0001
Died	376 (13.2)	188 (16.8)	188 (11.0)	<.0001
Default	433 (15.3)	209 (18.6)	224 (13.0)	<.0001
WHO stage at start of ART: Number (%)				
1 & 2 with CD4<200/mm^3	420 (14.8)	155 (13.8)	265 (15.4)	0.232
3	1832 (64.6)	704 (62.8)	1128 (65.7)	0.104
4	586 (20.6)	263 (23.4)	323 (18.8)	0.003
WHO stage: Number (% of alive and on ART)				
1 & 2 with CD4<200/mm^3	420 (85.0)	155 (75.5)	265 (90.6)	<.0001
3	1832 (72.1)	704 (65.3)	1128 (76.2)	<.0001
4	586 (60.1)	263 (56.3)	323 (63.2)	0.091
Body mass index: Number (% of alive and on ART)				
<17	194 (78.2)	81 (72.3)	113 (83.1)	0.041
17 ~ 18.4	277 (85.2)	113 (83.7)	164 (86.3)	0.513
18.5+	1537 (88.6)	524 (84.5)	1013 (90.9)	<.0001
Occupation: Number (% of alive and on ART)				
Business	592 (80.4)	220 (74.1)	372 (84.1)	0.003
Farmer	293 (82.3)	148 (77.7)	145 (86.9)	0.039
Teacher	135 (87.4)	47 (83.0)	88 (89.8)	0.257
Student	75 (72.0)	36 (69.4)	39 (74.4)	0.797*
Soldier/Police	26 (80.8)	18 (77.8)	8 (87.5)	1.000*
Health worker	46 (91.3)	12 (91.7)	34 (91.2)	1.000*
Housewife	635 (76.9)	0 (0.0)	635 (76.9)	-
Other	1036 (56.9)	641 (55.9)	395 (58.5)	0.406

Comparisons performed by chi-square tests; *P* value was to test the difference of survival rates between males and females.

● means comparisons performed by Fisher's exact test. 830 cases have no data of body mass index.

Table 3-2. Hazard ratios (HR) with 95% confidence interval (CI) of mortality based on the Cox proportional hazard model of 2838 AIDS patients receiving ART at Rainbow Clinic of Mzuzu Central Hospital, Malawi

Variables	HR (95%CI)	*P*-value
Gender		
Male (reference group: Female)	**1.70 (1.35-2.15)**	**<0.001**
Age (yrs)		
15-24 (reference group: >55)	2.64 (1.27-5.87)	0.009
25-34 (reference group: >55)	2.26 (1.23-4.64)	0.007
35-44 (reference group: >55)	2.26 (1.25-4.60)	0.005
45-54 (reference group: >55)	1.39 (0.73-2.94)	0.328
BMI		
<17 (reference group: ≥ 18.5)	**1.52(1.10-2.07)**	**0.011**
17-18.5 (reference group: ≥ 18.5)	1.09(0.79-1.49)	0.596
WHO stage		
3 (reference group: 1 & 2)	**2.52(1.56-4.39)**	**<0.001**
4 (reference group: 1 & 2)	**5.25(3.18-9.27)**	**<0.001**

Table 4-1. Baseline characteristics of 505 children on antiretroviral therapy at Mzuzu Central Hospital, Malawi stratified by body mass index

Variables	Total (N=505) Number (%)	BMI <=13.0 (N=91) Number (%)	BMI 13.1-15.0 (N=183) Number (%)	BMI 15.1-17.0 (N=166) Number (%)	BMI > 17.1 (N=65) Number (%)	*p* value
Sex, Female	242 (47.9%)	42 (17.4)	87 (36.0)	83 (34.3)	30 (12.4)	0.920
Male	263 (52.1%)	49 (18.6)	96 (36.5)	83 (31.6)	35 (13.3)	
Age, <= 1.5 years	40 (7.9%)	10 (25.0)	19 (47.5)	5 (12.5)	6 (15.0)	0.025
1.5 - 5 years	166 (32.9%)	29 (17.5)	51 (30.7)	57 (34.3)	29 (17.5)	
6 - 15 years	299 (59.2%)	52 (17.4)	113 (37.8)	104 (34.8)	30 (10.0)	
WHO Stage, 1 & 2	74 (14.7%)	5 (6.8)	20 (27.0)	33 (44.6)	16 (21.6)	<0.001
3	392 (77.6%)	67 (17.1)	151 (38.5)	130 (33.2)	44 (11.2)	
4	39 (7.7%)	19 (48.7)	12 (30.8)	3 (7.7)	5 (12.8)	
Outcome, Alive	342 (67.7%)	49 (14.3)	112 (32.7)	123 (36.0)	58 (17.0)	<0.001
Died	82 (16.2%)	28 (34.1)	37 (45.1)	15 (18.3)	2 (2.4)	
Transfer out	54 (10.7%)	6 (11.1)	23 (42.6)	22 (40.7)	3 (5.6)	
Lost to follow up	27 (5.3%)	8 (29.6)	11 (40.7)	6 (22.2)	2 (7.4)	
Orphan, Non	342 (67.7%)	49 (14.3)	112 (32.7)	123 (36.0)	58 (17.0)	<0.001
Paternal	82 (16.2%)	28 (34.1)	37 (45.1)	15 (18.3)	2 (2.4)	
Maternal	54 (10.7%)	6 (11.1)	23 (42.6)	22 (40.7)	3 (5.6)	
Double	27 (5.3%)	8 (29.6)	11 (40.7)	6 (22.2)	2 (7.4)	

s.d. = standard deviation, body mass index (BMI in Kg/m^2)

Table 4-2. Comparison of BMI at the beginning and follow-up visits, stratified by WHO stages and outcomes of 505 children on antiretroviral therapy

	Month 0		Month 1		Month 3		Month 6		Month 9		Month 12	
WHO stage	No.	Mean±S.D.*	No.	Mean±S.D.*	No.	Mean±S.D.	No.	Mean±S.D.	No.	Mean±S.D.	No.	Mean±S.D.
I &II	52	15.47±1.84	38	16.09±1.97	39	16.44±1.52	37	16.54±1.27	34	16.43±1.36	22	16.74±1.41
III	356	14.98±1.81	259	15.53±3.19	267	16.00±1.99	250	16.11±2.00	224	16.21±1.96	201	16.52±1.98
IV	97	13.87±2.20	62	14.56±2.21	52	16.12±2.16	51	16.47±3.04	44	17.14±1.84	34	17.24±1.73
Outcome	No.	Mean±S.D.*	No.	Mean±S.D.*	No.	Mean±S.D.*	No.	Mean±S.D.	No.	Mean±S.D.	No.	Mean±S.D.
Alive	342	15.11±1.93	321	15.56±1.88	298	16.18±1.77	284	16.34±1.74	269	16.50±1.67	225	15.97±2.51
Died, before next visit	21	13.90±1.86	23	13.38±2.08	14	14.84±2.16	4	15.17±3.08	3	15.26±1.18	4	17.18±2.02
after next visit	61	13.76±1.79	38	14.36±1.85	24	14.93±2.34	20	16.24±2.38	17	16.64±2.11	13	16.63±1.95

* means p value < 0.05
"Died before next visit" means patients died before his/her next follow-up.
"Died after next visit" means those deceased patients who died after the next follow-up.

TABLE 4-3. Areas under the curve (AUCs) and cutoffs from the receiver operating characteristic curves of WHO stage, body weight, body height, BMI, weight-for-height as predictors of mortality in 505 AIDS children on antiretroviral therapy

	AUC	S.E.	Asymptotic significance	Cutoffs	Sensitivity	1-Specificity
WHO stage at Month 0	**0.668**	0.029	0.000	3.5	0.40	0.13
Weight on Month 0	0.650	0.034	0.000	13.4	0.59	0.36
Month 1	0.667	0.043	0.000	15.3	0.71	0.44
Month 3	0.619	0.057	0.027	15.3	0.65	0.40
Height on Month 0	0.607	0.036	0.001	91.3	0.53	0.32
Month 1	0.603	0.047	0.016	100.1	0.61	0.43
Month 3	0.578	0.059	0.152	100.3	0.57	0.43
Weight/Height on Month 0	**0.683**	0.033	0.000	13.5	0.58	0.27
Month 1	**0.706**	0.041	0.000	14.4	0.65	0.33
Month 3	0.661	0.058	0.003	15.3	0.70	0.36
BMI on Month 0	**0.707**	0.029	0.000	14.7	0.73	0.41
Month 1	**0.734**	0.037	0.000	15.3	0.80	0.44
Month 3	0.670	0.061	0.002	14.7	0.50	0.19

Under the nonparametric assumption
S.E.= standard error
Significantly different from AUC = 0.50, $p < 0.05$.

Table 4-4. Adjusted hazard ratios (HR) with 95% confidence interval (CI) of mortality based on the Cox proportional hazard model of 505 AIDS children receiving ART at Rainbow Clinic of Mzuzu Central Hospital, Malawi

Variables	HR (95%CI)	*p* value
Gender		
Male (reference group: Female)	1.08 (0.67-1.74)	0.755
Age (yrs)		
<1.5 (reference group: 6-14 years)	2.17 (0.99-4.76)	0.054
1.5-5 (reference group: 6-14 years)	1.29 (0.72-2.30)	0.392
BMI		
<=14.7 (reference group: > 14.7)	**2.97 (1.73-5.11)**	**<0.001**
WHO stage		
3 (reference group: 1 & 2)	1.00 (0.35-2.86)	1.000
4 (reference group: 1 & 2)	**3.09 (1.01-9.44)**	**0.048**
Orphan status		
Yes (reference group: Non-orphan)	1.01(0.60-1.72	0.965

附錄一：

本博士論文發表的四篇論文標題、刊登雜誌與主要結論

第一篇論文：Page 59 ~

Applying global positioning system and Google Earth to evaluate the accessibility of delivery services for pregnant women in northern Malawi (Accepted by ***Journal of Midwifery and Women Health****,* SCI/SSCI, in press)

主要結論：本文發現距離是產婦選擇生產地點的最重要因素。GPS 結合 Google Earth 能客觀測量產婦到醫療院所需要的距離和時間，有助於醫療可近性的評估和及早因應生產過程的緊急狀況。結合此兩種工具，可以幫助我們瞭解醫療資源的分佈，以作為公共衛生決策上的參考。

第二篇論文：Page 76~

The effectiveness of continuing training for traditional birth attendants on their reproductive health care knowledge and performance (Accepted by ***Midwifery****,* SCI/SSCI, in press)

主要結論：本文發現經過訓練和再教育的傳統接生婆能夠有良好的表現，她們所接生的嬰孩，死亡率不到全國平均值的一半。接生婆可以是發展中國家婦幼衛生的重要人力資源，但前提是需要給他們良好的訓練和持續再教育，而且再教育每年應至少舉辦一次。

第三篇論文：Page 91~

Increased mortality of male adults with AIDS related to poor compliance to antiretroviral therapy in Malawi. (Published in ***Tropical Medicine International Health***, volume 13 no 4 pp 513–519 April 2008)

主要結論：本文發現在接受愛滋病治療的成人中，男性的存活率比女性差，達統計顯著，這可能和男性較晚被診斷、接受治療時的臨床嚴重度較高、較高比率失去追蹤和較差的遵醫囑性有關。這點提醒我們在推廣愛滋病藥物治療時，應注意性別差異可能帶來的影響。

第四篇論文：Page 103~

Body mass index as a significant predictor for survival of children on antiretroviral treatment: A five-year follow-up study in Malawi (Finished manuscript)

主要結論：本文發現嚴重營養不良是兒童愛滋病死亡的重要原因，BMI 甚至比 WHO 臨床分級對預後具有更好的預測效果。一開始的 BMI 若小於 15 kg/m^2，會有三倍高的死亡機率。營養不良對於死亡的影響在開始治療的前三個月特別顯著，所以早期的營養評估和介入應該整合在愛滋病童的治療計畫中。

Journal of Midwifery & Women's Health

June 2, 2010

To Whom It May Concern:

I am writing to confirm that the *Journal of Midwifery & Women's Health* has accepted for publication the article titled **Applying global positioning system and Google Earth to evaluate the accessibility of delivery services for pregnant women in northern Malawi**, by Solomon Chih-Cheng Chen, M.D., M.PH., Jung-Der Wang, M.D., Sc.D., Joseph Kwong-Leung Yu, M.D., Ph.D., Tzu-Yi Chiang, M.Sc., R.N., Chang-Chuan Chan, Sc.D., Hsiu-Hung Wang, Ph.D., M.Sc., R.N., Yohane M. Z. Nyasulu, Ph.D. and Rose Kolola-Dzimadzi M.Sc., S.R.N., S.R.M.

This paper is currently scheduled to appear in the January/February 2010 issue of *JMWH*. However it does not reflect an accept status because *JMWH* is changing publishers. During this transition, accepted articles that will appear in 2011 are being held in the *JMWH* editorial office and will be forwarded to the new publisher once the database is established. We anticipate the movement of these articles to the new publisher's database over the summer of 2010.

Thank you for your patience as we make this transition.

Sincerely,

Stephanie Bergwall
Managing Editor
Journal of Midwifery & Women's Health
jmwh@acnm.org

Applying global positioning system and Google Earth to evaluate the accessibility of delivery services for pregnant women in northern Malawi

ABSTRACT

Objective. To validate the combined use of global positioning system (GPS) and Google Earth for measuring the accessibility of health facilities for pregnant women in northern Malawi.

Methods. We used GPS and Google Earth to identify five major health facilities in Mzuzu and 79 traditional birth attendants' (TBAs) homes. The distance and time required for each TBA to reach the nearest health facility were measured by both GPS and TBAs report. A convenience sample of 1138 pregnant women was interviewed about their choices of delivery sites for current and previous pregnancies, and time and cost required to access health facilities.

Results. The correlation coefficient between the objective measurements by GPS and subjective reports by TBAs for time required from their homes to health facilities was 0.654 ($p < 0.001$). Among pregnant women, 45.6% reported they could reach the health facilities within two hours; 23.8% reported to pay more than U.S. $1 on transportation. For current pregnancy, 82.6% of women intended to deliver babies at health facilities, but for previous pregnancies only 48.7% of them actually delivered babies there, and 32.6% were assisted by TBAs.

Conclusion. Combined GPS and Google Earth can be useful in the evaluation of health accessibility, especially for emergency obstetric care.

INTRODUCTION

Improving maternal health is the fifth Millennium Development Goal and the World Health Organization (WHO) has identified accessibility to skilled birth attendants as an important indicator of the progress in maternal mortality reduction efforts.[1] However, many developing countries still suffer from a shortage of skilled medical professionals. This results in persistently high perinatal and maternal mortality, especially in some areas of Sub-Saharan Africa and Asia.[2, 3]

Malawi is a developing country in southeastern Africa with a high maternal mortality ratio (MMR) which was estimated to be around 1,000 maternal deaths per 100,000 live births based on the 2004 Malawi Demographic and Health Survey,[4] WHO statistics and other studies.[5-7] The brain drain of medical professionals and the frequent shortage of medical supplies and medications may contribute to the high maternal mortality rate.[5, 8, 9] The Taiwan Medical Mission (TMM) to Malawi, based at Mzuzu Central Hospital in northern Malawi, worked closely with Malawian medical staff to improve the health status of the Malawian people from 2000 until 2007. During our service, the TMM initiated a training project for existing traditional birth attendants (TBAs) after consulting with the Malawian Health Authority. Though Mzuzu city is a major city in the northern Malawi, most parts of the city and its surrounding regions are under-developed and look like rural areas. We recruited TBAs from different rural villages surrounding the Mzuzu city on the principle of "one village, one TBA" in order to cover as many rural areas as possible.

Based on the successful experience of TMM's using fingerprint identification system to help management of anti-retroviral drugs for AIDS patients,[10] we thought about applying some modern information tools like geographic information system (GIS) such as global positioning system (GPS) and Google Earth to help evaluate the accessibility of pregnant women for delivery services at Mzuzu city. Recently, GIS has been used in various types of health care services, including the modeling of traveling time or distance to government health services,[11-13] defining the geographic access to clinical services,[14-17] and assisting infection control of malaria and parasites.[18, 19] Google Earth, a newly introduced virtual globe mapping tool, can visualize almost any place in the world. Its application for health-related issues has also started recently. For example, Google Earth has been used for community mapping and for tracking the polio virus down the Congo River.[20-23] In recent years, some studies have used both GPS and

Google Earth for public health programs like dengue surveillance system and vector-borne diseases management. Such a combination demonstrates their potential usefulness to strengthen public health planning and capacity.[24, 25]

The objectives of this study were (1) to introduce the combined use of GPS and Google Earth to estimate the physical accessibility of health care facilities for pregnant women in Mzuzu in northern Malawi, (2) to validate the measurements of GPS by comparing with subjective judgments from TBAs about the time required for the emergency referral of complicated pregnancy to the nearest health care facility, and (3) to examine the role of distance to the health facility in pregnant women's choosing delivery place for previous and current pregnancies.

METHODS

Interviewing pregnant women

Since Malawi has no household registry, we used a convenience sample for this survey. During the study period between July and August 2007, we visited all health care facilities providing antenatal care services for pregnant women in Mzuzu, including hospitals, health centers, primary health stations and the homes of TBAs. A total of 1138 pregnant women consented and were interviewed with a structured questionnaire. This questionnaire was designed by three senior midwives in Mzuzu Central Hospital with extensive experience in reproductive health services. A pilot study was conducted by interviewing with ten pregnant women at health care facilities or TBAs' homes, and their responses were carefully considered to modify the wordings of questionnaire and to improve its feasibility and accuracy. All interviewers were medical staff from the Mzuzu Central Hospital. They have received interview training and the interviews were conducted in the local language. We used this questionnaire to collect pregnant women's basic demographic information, their choices of sites for antenatal care, the preferred delivery location, and reasons for preferring that location for their current pregnancies, and actual delivery sites and reasons for their previous pregnancies. They were also asked about the transportation methods, costs and time required for them to reach the health care facilities from their residences.

Using GPS and Google Earth to show the geographic distribution

We used GPS to identify the exact longitude and latitude of the homes of 79 TBAs and all five health care facilities in this region, including Mzuzu Central Hospital (MC), Saint Johns District Hospital (S), Ekwendeni District Hospital (E), Mzuzu Health Center (MH) and Choma Health Center (C). We used ArcGIS 9 ArcMap software (ESRI, Redlands, CA USA) to integrate the geographical data collected by GPS on the satellite imagery taken from Google Earth to show their locations. All TBAs were

categorized into five groups according to which one of these five health care facilities they would generally refer pregnant women to if complications occurred during the pregnancy. A specific identification number and color was given to each TBA and health care facility on the map, as seen in Figure 1.

Using GPS to measure the distance for emergency referral from every TBA

We tried to quantify the distance and time required for pregnant women to access the health care facilities. However, we did not have the exact locations of the homes of pregnant women for there is no formal home address in rural Malawi. It was also difficult to get this information from interviewing pregnant women, because they usually have no clear idea of the distances from their houses to health care facilities. Since all TBAs came from the villages where the pregnant women resided and were well known by local people, they were usually the closest helper for pregnant women in the villages, and were also the key persons to identify the risky pregnancy for early transfer. Thus, we used the TBAs' houses as the proxy locations for the pregnant women in different villages.

GPS was used to record the route and distance from an individual TBA to her nearest health care facility. We followed the routes that TBAs would usually take to refer women to the nearest health care facility, and used GPS to record the pathway, distance and time required for each route. The transportation time estimated by GPS was defined as the distance measured by GPS divided by the average Malawian walking speed of 5 kilometers per hour; this was an estimate based upon actual observations of the usual Malawian walking speed. In addition, we also interviewed TBAs to collect the detailed information of their transfer of pregnant women to the nearest health care facility, including the transportation methods, monetary costs and time required from their homes. Then we compared the transportation time objectively measured by GPS

and the transportation time subjectively reported by TBAs to check their consistency.

Approval of the training project and Ethics Review

This training project for traditional birth attendants has been approved by the Ministry of Health of Malawi and the Department of Health of the Mzuzu City Assembly. The Ethics Review Board of Mzuzu University of Malawi approved the protocol of this study, and all participants provided oral or written informed consent.

Analysis and Statistics

The univariate analysis summarized the average time required and transportation cost for pregnant women to reach health facilities, as well as the frequencies and proportions of antenatal care visits or babies delivered in different sites of health care facilities or TBAs' homes. The association between the reasons of preference and delivery sites was tested by Chi-square test. Consistency between the transportation times measured by GPS and reported by TBAs was tested by correlation coefficient. Data were analyzed using SPSS software (version 16.0 for Windows, Apache Software Foundation, USA).

RESULTS

Interviewing pregnant women for the information of time required, transportation costs and delivery sites

The mean (standard deviation) age of these pregnant women (n=1138) was 24.7 (2.3) years old. The transportation costs and times required for these pregnant women to reach the health care facilities from their homes were summarized in Table 1-1. Although about three-fourths of pregnant women estimated the transportation cost to be less than U.S. $1, it also showed that only 24.0% of the surveyed women could reach the nearest health care facility within one hour, 21.6% between one and two hours, and the remainders needed more than two hours.

The sites pregnant women went for antenatal care and delivery (actual for previous pregnancies, intended for current pregnancies) are listed for comparison in the Table 1-2. For the current pregnancy, most pregnant women chose the health care facilities for their antenatal care (79.7%) and intended to deliver there (81.8%). However, for their previous pregnancies, less than half of the women actually delivered at the health care facilities, while about 30% delivered at TBA homes and 3.6% at their own homes. The reasons of preference among pregnant women for selection of delivery sites at health care facilities or TBAs are compared in Table 1-3. “Reliable skill and experience” and “adequate facility” are two major preference reasons of pregnant women to deliver babies at health care facilities. However, for TBA, it is the “near by my house” as the major reason of preference.

GPS and Google Earth for evaluation of access to public health resources

The TMM recruited and trained a total 81 TBAs during 2004 and 2006. Two TBAs were not at home during our survey period and the remaining 79 TBAs were surveyed. The map in Figure 1 shows the exact locations of five health care facilities and the 79

TBAs' houses in Mzuzu city in the northern region of Malawi. The Google Earth image revealed that Mzuzu city is located in a valley surrounded by small hills. Four of the five health facilities are situated on or near major roads; only the Choma Health Center is on a hilly region without paved road access. Two TBAs, E522 and E525, though closer to the Choma Health Center than to the Ekwendeni Mission Hospital, are on the opposite sides of a mountain from the former. There are no paved roads connecting these two TBAs to the Choma Health Center, so these two TBAs generally refer patients to the Ekwendeni Mission Hospital in case of emergency.

The transportation times estimated by GPS and reported by the TBAs are summarized for comparison in Table 1-4. These two sets of estimations were highly correlated with a correlation coefficient of 0.654 ($p < 0.001$). The estimated cost of transferring pregnant women to the nearest health care facility in emergency situations ranged from U.S. $0.40 – $40.00 and averaged $11.70 (Table 1-4), depending on what kind of transportation method used, such as walking, mini-bus, motorcycle or taxi. The transportation costs rose steeply for emergency transfer from TBAs' homes to the nearest health facility, varying from U.S. $3.40 to U.S. $29.30 (Table 1-4)

DISCUSSION

This study tries to address an important issue of the physical inaccessibility of maternal health care for women through the use of GPS and Google Earth in a resource-limited environment. Through the comparison between the objective measurements by GPS and Google Earth and subjective estimates by TBAs, we validated GPS and Google Earth as the reliable tools for health accessibility evaluation.

Lack and unequal distribution of health care facilities, long distances and unavailability of transportation are often the obstacles that preclude people from reaching health services in both developing and developed countries.[14, 17, 26, 27] The time required to reach the health facilities is decided by the distance divided by the travel speed which mostly depends on the transportation method and road condition.[28] In the northern region of Malawi, around 200,000 residents are distributed widely over a large mountainous area as shown in Figure 1. Most people usually reach their destinations on foot, and distance and transportation is a real problem for accessibility of health service to the general population. Our results showed that less than half of pregnant women could reach health care facilities for antenatal care within two hours (Table 1-1). Thus, it is not surprising that although most pregnant women (82.6%) would like to deliver their babies at health care facilities for their current pregnancy, only 48.7% of previous deliveries occurred at these facilities (Table 1-2). It corroborates with a previous study also conducted in Malawi that although many pregnant women received antenatal care at hospitals, few of them actually went back to hospitals for delivery.[29]

Further analysis to check the association between the reasons of preference and women's selection of delivery sites in Table 1-3, "nearby my house" is the most important reason for TBAs, but not a major reason for health care facilities, in both current and previous pregnancies. This finding showed us a truth that TBAs are the

nearest available resource for pregnant women. When the labor pain starts and progresses, it could be difficult for a pregnant woman to walk for more than two hours. So, the pregnant woman may choose to deliver in a nearby convenient site with kind assistance from a TBA rather than go to a distant health care facility. In our study sample, 41 pregnant women even delivered their babies at home and 35 of them were assisted by TBAs who went to women's houses to help. Thus, there are nearly one third of babies actually delivered by TBAs (Table 1-2). This finding, consistent with previous studies, showed that TBAs may still play an important role in the delivery services especially in rural areas of developing countries with a shortage of health care facilities and skilled birth attendants.[26, 29, 30]

The Table 1-4 shows that the average distances from the homes of 79 TBAs to their nearest health care facilities ranged from 5.7 km to 31.4 km, with the longest distance being up to 51.5 km. The average transportation time ranged from 1.1 to 6.3 hours. In general, the transportation cost for pregnant women to reach health care facilities may not seem too high, as 74.9% of the women spent less than U.S. $1 to do so (Table 1-1). But, it is still a burden for people in a low-income country like Malawi with a per capita GDP of $800 (2008 estimated).[31] Moreover, the emergency transportation usually costs several times higher than the regular mode (Table 1-4), because it has to be faster and may be needed at night, which are usually necessary when a serious complication during delivery occurs and should be arranged in the last minute to save lives of mothers and babies. Such a gap between emergency and regular transport costs can explain why women usually go to health facilities for regular antenatal care, but about one-third of them actually delivered babies at TBA sites possibly because of emergency and saving money. A reference said that a high transportation costs can be a major barrier for resource-limited people trying to access

qualified health care services in developing countries.[26]

The Google Earth has some attractive advantages. First, it has free version and readily available on the internet. Second, it is very popular and friendly to use, with over 400 million related products used worldwide.[32] Third, it can see almost every place in the world. Since GPS can provide the exact information of longitude and latitude of any location in the world, we integrated GPS information with Google Earth information to show the spatial distribution of all health care facilities and major roads in Mzuzu city as in Figure 1. Such integration is able to produce a resourceful mapping, which may be useful on the health policy making such as where to build a new health center for reduction of health inequity. We propose that such uses be promoted to improve the public health capacity.

In addition to identifying the exact location, GPS also can record the pathway, distance, time and speed of any mobile vehicle. Because of these characteristics, GPS can give us an accurate measurement of the distance and transportation time required for transferring pregnant women to obstetrical health care services in case of an emergency. We can thus identify the transportation route on the map and its required time for an emergency referral, which is useful for emergency planning of every TBA. For example, when one complicated pregnancy is identified and emergency transfer is indicated, TBA can call the nearest health facility where her GPS location is or just tell her TBA number on a map like our Figure 1, and how soon the pregnant woman will arrive through which route and by what kind of transportation method. From July 2004 until June 2007, there were 170 women referred by our trained TBAs. Although all the mothers were saved, there were 26 infant deaths among 1905 newborns delivered by 1984 pregnant women visited TBAs' sites.[33] We would suggest a planning and communication in advance for such an emergency transfer to further reduce the

perinatal mortality.

This study has some limitations. The first one was the sampling method of pregnant women in the Mzuzu area. Since there is no household or population registry in Malawi, we were unable to know the exact distribution of the general population and to calculate the sampling size. What we could do was a convenience sampling to interview all pregnant women at all hospitals, health centers, primary health stations and homes of TBAs during the study period. Second, it was difficult for us to know the exact delivery sites of pregnant women for their current pregnancy. As rural Malawian people rarely moved their homes, we used the delivery site of the previous pregnancy, which has already happened, as a proxy in order to reflect the proportion of possible delivery sites. Third, there were 16% - 18% of missing data from the interviewed pregnant women. The major reason was possibly due to the low literacy rate of Malawian women living in rural area.

CONCLUSION

Since Google Earth and GPS are very exact and not subject to human error in estimating distance, this kind of information technology may carry more political weight than the voices of the women on their actual inaccessibility to health services. This study provides the first empirical example of combining GPS and Google Earth to evaluate the accessibility of pregnant women for delivery services and with the potential to improve access to emergency obstetric care in a developing country. We documented that the measurements of distance and time required by GPS are highly consistent with the subjective estimates of TBAs. Since Google Earth can be freely downloaded from internet and the cost of GPS may not be too high, we recommend that the integration of these two tools be promoted and introduced to other parts of the world to aid health planning and policy making.

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Letter for Accepted Manuscript

December 23, 2009

Ms. Ref. No.: YMIDW-D-09-00126R1

Title: The effectiveness of continuing training for traditional birth attendants on their reproductive health care knowledge and performance

Dear Dr Joseph Kwong-Leung Yu,

I am pleased to inform you that your paper "The effectiveness of continuing training for traditional birth attendants on their reproductive health care knowledge and performance" has been accepted for publication in Midwifery.

Thank you for submitting your work to Midwifery.

Yours sincerely,

Debra Bick, BA, MMedSc, PhD, RM

Editor-in-Chief

Midwifery

The effectiveness of continuing training for traditional birth attendants on their reproductive health care knowledge and performance

ABSTRACT

Objective: To evaluate the effectiveness of continuing training for trained traditional birth attendant (TBA) on their reproductive knowledge and performance

Setting: Mzuzu Central Hospital in the northern region of Malawi

Participants and analysis: A total of 81 TBAs trained during 2004 and 2006 in Mzuzu, Malawi received continuing training courses. Their reproductive knowledge was assessed by a structured questionnaire during 2004 and 2007. A multivariate generalized estimating equation (GEE) model was constructed to determine the associations between their reproductive knowledge scores and age, years of education, time since the last training course, test frequency and number of babies delivered.

Findings: From July 2004 to June 2007, a total of 1,984 pregnant women visited these trained TBAs. A total of 79 (4.0%) mothers were referred to health facilities before delivery due to first-born or difficult pregnancies. No maternal death occurred among the remaining mothers. There were 26 deaths among 1,905 newborn babies, giving a perinatal mortality rate of 13.6 per 1,000 live births. The GEE model demonstrated that knowledge scores of TBAs were significantly higher for TBAs under the age of 45, TBAs with more than five years of education, TBAs who had taken a training course within one year, and TBAs with a higher test frequency.

Conclusion and implications for practice: Continuing training courses are effective to maintain the reproductive knowledge and performance of trained TBAs. We recommend that continuing training should be regularly offered, at least annually.

INTRODUCTION

Improving maternal health has been identified as the fifth Millennium Development Goal (MDG), and one of the indicators of progress toward this goal is an increase in the proportion of deliveries attended by a skilled birth attendant (SBA) (WHO, 2004). However, success in this area depends on how many SBAs are available, and there is currently a global deficit of doctors, nurses and midwives in the developing world (WHO, 2004). One survey found that only 47% of births in Africa are assisted by SBAs (Shah and Say, 2007). This means that recruiting professional SBAs to work in remote areas is still a distant reality for many developing countries.

The country of Malawi, located in southeastern Africa, has a very limited number of medical professionals as well as high maternal and perinatal mortality rates (van den Broek et al., 2003; WHO, 2007). Malawi had a national program for training traditional birth attendants (TBAs) that began in 1982, and more than 800 TBAs were trained and registered (Smit, 1994). However, this program was discontinued at the end of the 20th century when the Safe Motherhood Initiative redefined "skilled" birth attendants as medical professionals like doctors, nurses and midwives. This decision resulted in a global withdrawal of funding and support for TBA training; previously trained TBAs in Malawi were gradually neglected and received less and less education and/or support (Kruske and Barclay, 2004; Maine and Rosenfield, 1999; Starrs, 2006).

Though TBAs have received less support over the past decade, recent work indicates that TBA training has positive results on reproductive health in some developing areas (Jokhio et al., 2005; Sirivong et al., 2003). Some reviews of the subject have concluded that TBA training is associated with improvements in knowledge, increased use of antenatal care, improved attitudes and behaviors and a potential reduction in perinatal mortality (Sibley et al., 2004; Sibley and Sipe, 2004; Sibley et al., 2007; Sibley et al.,

2004). However, more data on the effectiveness of TBA training is needed before the global community can determine the future role of TBAs in reproductive health care. In addition to initial training, the role of continuing training for TBAs has not been well studied, particularly in low-literacy groups.

Faced with high maternal mortality and a severe shortage of SBAs in Malawi, the Taiwan Medical Mission (TMM), based at Mzuzu Central Hospital in northern Malawi, held a training program for TBAs from 2004 to 2006. The aim of this study was to evaluate the effectiveness of such training programs by measuring the TBAs' reproductive knowledge and by gathering data on the outcomes of the deliveries they assisted with. The additional objectives were to determine the effect of factors such as age and years of education of the TBAs, test frequency and time elapsed from the last course on knowledge scores. This data may help in the future planning of continuing training for TBAs in low-resource settings.

METHODS

Taiwan Medical Mission and the Traditional Birth Attendant Project

The TMM was located in Mzuzu City, the major city in the northern region of Malawi. The city has a population of approximately 200,000 and occupies an area of 26,931 km^2. To address the high perinatal mortality rate resulting from poor access to qualified medical professionals and health facilities in this region, the TMM initiated a training project for existing TBAs to improve their reproductive knowledge and practices. We applied the principle of "one village, one TBA" to the recruitment process to cover as many rural areas as possible. We consulted local authorities and leaders to identify currently practicing TBAs in the villages surrounding Mzuzu City. In general, there were about 1,500 to 3,000 people in each village; the exact number is uncertain due to the lack of a formal household registration system.

The TBAs in rural Malawi were usually enthusiastic women who were well known in their villages. Many of them had learned from experience by occasionally attending deliveries and assisting in neighboring women's deliveries; others had learned from their mothers or sisters, who were already experienced TBAs in the community. Their services were usually free of charge. The mean age of these trained TBAs was 53.8 ± 4.6 years old. Their mean duration of formal education was 4.1±3.2 years. Because every TBA was recruited through the recommendation of a local authority or leader, it was a great honor for them to take part in this project and no one declined. To assure quality, the TMM project could only train a limited number of TBAs each year (23 in 2004, 34 in 2005 and 24 in 2006, which resulted in a total of 81 trained TBAs). Thus, TBAs recruited in different calendar years were followed for different periods of time. No TBAs failed to follow-up with the program during the period of training and evaluation.

After they were recruited, the TBAs received one month of intensive training at Mzuzu Central Hospital. The training courses included topics like antenatal and perinatal care, safe deliveries, the recognition of high-risk pregnancies and indications for referral to local healthcare facilities. The indications for referral were highlighted and illustrated in figures on a transfer sheet. Special conditions, such as severe anemia, malnutrition, young primipara, grand multipara and HIV-positive status were included as transfer indications. During the training course, the TBAs were able to observe SBAs and to deliver babies under the supervision of SBAs at the Mzuzu Central Hospital. After passing a qualification exam that evaluated their competency in reproductive health, the TBAs were equipped with essential medicines including anti-malaria medication (sulfadoxine-pyrimethamine), iron tablets, folic acid and some simple delivery supplies. The TBAs were visited at least once every three months by senior Malawian nurses and TMM staff who gave them logistical support, including the replenishment of essential medicines and delivery equipment. To facilitate the correct recording of delivery data by the TBAs, we designed a special form that depicted the different types of risky pregnancies in figures intended to overcome illiteracy barriers. The supervising staff regularly checked and collected these forms.

Continuing training and periodic evaluation tests for TBAs

One year after the initial training course, all TMM-trained TBAs were invited to attend a continuing training course at Mzuzu Central Hospital. The one-month course was designed to refresh their reproductive health knowledge. A senior midwife used a structured questionnaire to test their knowledge of reproductive health either before or after their most recent course. The questionnaire had a total of 47 questions that covered 4 areas: antenatal care (9 questions), delivery (14 questions), postnatal care (11 questions) and general practice (13 questions). The point scales for each question

ranged from 0 to 3, and the total score for a test ranged from 0 to 141. When the TMM project first began in 2004, we only offered one evaluation at the end of training. During the course of the program, however, we found that evaluation could improve the training's effectiveness. As a result, we increased the testing frequency to five times for TBAs recruited in 2005 and four times for those recruited in 2006. The age and education level of the TBAs, test scores, testing frequency and time elapsed since the last course are summarized in Table 2-1.

Analysis and statistics

The univariate analysis summarized the age and education level of the TBAs, test scores, testing frequency and time elapsed since the last course. The maternal referral rates and perinatal mortality rates were calculated and stratified by maternal age. A multivariate generalized estimating equation (GEE) model (Zeger and Liang, 1986) was constructed with the reproductive knowledge scores obtained through repeated measurements as the dependent variable, while the TBAs' ages, years of education, test frequency, time elapsed since last training course and babies delivered per year were included as the independent variables. The data were analyzed using the SAS software package (Version 9.1.3, SAS Institute Inc. Cary, NC, USA).

Ethics Approval

The Ethics Review Board of Mzuzu University approved the study protocol and all of the participants have provided either written or oral informed consent.

FINDINGS

Characteristics and knowledge scores of the TBAs

The TBAs' basic characteristics (i.e., age, years of education, time since their last training course and evaluation scores) are summarized in Table 2-1 and are stratified by the year in which they were trained.

Maternal mortality and referral rates of 1,984 mothers visiting trained TBAs

From July 2004 to June 2007, a total of 1,984 pregnant women visited and delivered their babies at the home clinics of TMM-trained TBAs. No maternal deaths occurred among these mothers. A total of 170 (8.6%) mothers were referred to the nearest health facility, 79 (4.0%) before and 91 (4.6%) after delivery (Table 2-2). The major reasons (and the number of occurrences) for maternal referrals were as follows: primigravida (31), previous caesarian section (15), prolonged labor (13), premature rupture of membrane (8), retained placenta (8), abnormal presentation (breech or transverse) (7), twins (6), postpartum hemorrhage (5) and others (37). The main reasons (and the number of occurrences) for neonatal referral were as follows: prematurity (12), low birth weight (6), respiratory distress (4), abnormality (1) and others (4).

Perinatal mortality rates of 1,905 babies born in TBA homes

Excluding the 79 mothers who were referred to hospitals before delivery, a total of 1,905 babies were delivered at the TBAs' home clinics. Among them, there were 26 infant deaths (a perinatal mortality of 13.6 per 1000 live births). Both the maternal referral rates and perinatal mortality rates were significantly different across the three maternal age groups ($p < 0.05$ by the Poisson distribution test), as summarized in Table 2-2. These 26 newborn deaths were distributed over 17 TBAs who were found to have lower test scores ($p = 0.004$) and fewer years of education ($p = 0.399$), as summarized in Table 2-3. When we conducted a Spearman rank correlation test between the number of

years of education and the number of newborn deaths for each TBA, we found a correlation coefficient of -0.217 (p = 0.052), indicating a borderline trend between increased perinatal mortality and a shorter duration of education of TBAs. However, the TBAs who experienced perinatal mortality delivered about twice as many newborns as the TBAs who did not experience perinatal mortality (Table 2-3).

Changes in knowledge scores over time

The proportion of correct answers given by 25 TBAs on four successive reproductive knowledge tests is shown in Figure 1. The number of correct answers was highest just after the training and refresher courses, but it decreased gradually over time.

Multivariate analysis of knowledge scores by GEE model

As shown in Table 2-4, the GEE model indicated that higher TBA reproductive knowledge scores were significantly associated with younger age, more years of education of the TBAs, higher frequencies of tests and shorter durations elapsed since the last training course, but the scores were less associated with the average number of babies delivered. Further categorization of independent variables showed that test scores were significantly improved if the time between testing and the last training course was less than one year, if the TBA was less than 45 years old or if the TBA had more than five years of education.

DISCUSSION

This study explored the effectiveness of continuing training courses for TBAs who had already completed initial training; effectiveness was based on the evaluation of their reproductive knowledge and on the outcomes of their delivery services for 1,984 pregnant women. Multivariate analysis indicated that an annual schedule for continuing training was helpful in maintaining the TBAs' knowledge and performance.

To avoid the mismanagement of deliveries, TBAs were not allowed to assist with first-born or complicated deliveries in Malawi. They were instructed repeatedly in this training project to recognize such difficult cases early on and to transfer them to health facilities. There were no maternal deaths among the 1,984 women who visited the 81 trained TBAs between 2004 and 2007. One probable explanation for this low maternal mortality rate was the early and high referral rate (8.6%) of risky or complicated pregnancies to health facilities where professional obstetric care was available (Mavalankar and Rosenfield, 2005). As previously reported, training TBAs to recognize the signs of risky pregnancies (including using depictions in figures on a referral sheet) enabled them to identify and transfer dangerous cases promptly (Schaider et al., 1999; Walraven and Weeks, 1999). In addition, the low maternal mortality rate can also be partially attributed to the careful triage of cases by the TBAs. In fact, there were 79 (4.0%) women with-high risk pregnancies initially visited a TBA but were subsequently transferred to health facilities prior to delivery. We attempted to follow these cases and were assured that at least some of these cases did not end in maternal or perinatal mortality. However, we were unable to identify all of the transferred cases due to the incomplete medical records of the health facilities to which they were referred.

The perinatal mortality in this study was 13.6 per 1,000 live births, which is less than the national rate in Malawi as reported by the WHO (26 deaths per 1,000 live

births) (WHO, 2007) or by the 2004 Demographic Health Survey of Malawi (39 deaths per 1,000 live births in the Mzimba district and 40 deaths per 1,000 live births in the northern region where Mzuzu City is located) (NSO et al., 2005). Thus, the results of TBA training presented here demonstrate a significant improvement when compared to the national statistics. Our data is also consistent with the findings of previous studies, which concluded that trained TBAs have the potential to reduce perinatal mortality (Jokhio et al., 2005; Sibley et al., 2007). Unfortunately, the major reasons for perinatal death in this survey were not clear, as less than 20% of the TBAs had obtained an elementary school education and thus were unable to provide definitive diagnoses.

The 26 newborn deaths were distributed over 17 TBAs, who appeared to have significantly lower test scores than the TBAs who did not experience a death (Table 2-3). As there was no significant difference in the age or duration of education between these two groups, the potential impact of training on delivery outcomes must be considered. However, because the average number of newborns delivered by the TBAs who experienced perinatal mortality was approximately twice the number delivered by TBAs who did not experience a death, this interpretation of the results should be accepted with caution.

Maternal age was another important factor of perinatal mortality; a maternal age of less than 20 or more than 34 years was associated with a higher perinatal mortality rate (Table 2-2). While accessibility is an important factor in developing countries (Liljestrand and Pathmanathan, 2004; Mpembeni et al., 2007), we usually recruited a single TBA per village for training to maximize the coverage of such services and to minimize differences in accessibility. But because there was no formal house registration system in rural Malawi, we are unable to rule out poor access as a potential cause of higher perinatal mortality.

The way that the women learned midwifery was an important determinant of their practice (Carvalho et al., 1998). These TBAs usually started their delivery services accidentally and did not have formal training before practicing. Thus, providing them with a good training course including appropriate reproductive knowledge could be very important. Through this training project's supervised sessions, we were able to determine that training had a significant impact on the TBAs' performance. After the initial training courses, the majority of the TBAs felt more comfortable and more able to educate mothers about personal hygiene, childcare and family planning. The pregnant women in the villages also had more confidence in the trained TBAs and were more likely to seek their services. One systematic review found that TBA training may increase the antenatal care rate by approximately 38%, which would also help reduce maternal and perinatal mortality (Sibley et al., 2004).

In addition to the initial training courses, the continuing training (refresher) course also served a very important function (Kumar et al., 2000). Figure 1 shows that the percentage of correct answers on the knowledge test was highest just after the initial training but decreased to a very low level after a period of one year. Immediately after the refresher course, the percentage of correct responses returned to the previous level and remained at an adequate level three months later. This finding agrees with the conclusions of a previous study which indicated that TBAs who were not continuously supervised and supported might return to their original practices (Kamal, 1998). Moreover, using a GEE model, we determined that the amount of time elapsed since the last training course and the frequency of testing were significantly associated with reproductive knowledge scores (Table 2-4). If the time was longer than one year, the knowledge score decreased significantly. Based on this finding, we advocate an annual refresher course for TBAs. This schedule is also administratively convenient. Therefore,

continuing training courses are necessary at least annually to maintain the TBAs' reproductive knowledge, which is believed to be the foundation of good performance during deliveries.

The personal characteristics of the TBAs are also important factors associated with their knowledge scores. The GEE model in Table 2-4 demonstrates that TBAs under 45 years of age who had more than 5 years of school were significantly associated with higher reproductive knowledge scores after training. Thus, more continuing training should be offered to older TBAs and/or TBAs with less schooling.

The severe shortage of professional SBAs may be a major barrier to reaching the fifth Millennium Development Goal. We are now almost halfway from 2005 to the target year of 2015. One method to alleviate this shortage is to transform the potentially capable TBAs into "skilled" or more qualified birth attendants by providing them with proper training and close supervision (Sibley and Sipe, 2006). Including TBAs in the "mainstream" reproductive health care system may have some advantages because they fully understand the local culture and traditional habits that may influence a woman's decision to seek health care. The important cultural and social roles of TBAs in their communities can serve as a bridge between pregnant women and health care professionals (Kruske and Barclay, 2004). For example, in the Republic of South Africa, the majority of professional midwives agreed that TBAs can be helpful and should be recruited into the health care system after being properly trained (Nolte, 1998). It has also been suggested that integrating TBAs with professional midwives and doctors might be a cost-effective strategy for improving reproductive health in human resource-limited settings (van Roosmalen et al., 2005). However, it is extremely important to continuously supervise and educate low-literacy health care workers. Our study suggests that an annual schedule of continuing training should be developed with

the resources available.

Conflict of interest statement

All authors declare they have no conflicts of interest.

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Increased mortality of male adults with AIDS related to poor compliance to antiretroviral therapy in Malawi

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Increased mortality of male adults with AIDS related to poor compliance to antiretroviral therapy in Malawi

ABSTRACT

Objective: To investigate the effect of gender on mortality of HIV-infected adults receiving antiretroviral therapy (ART) and its possible reasons. **Methods:** A retrospective study to review the records for outcomes of adult cases receiving ART at Mzuzu Central Hospital, Malawi, between July 2004 and December 2006. **Results:** Over the study period, there were 2838 adult AIDS cases receiving ART. Of these, 2029 (71.5%) were alive and still on ART, 376 (13.2%) were dead and 433 (15.3%) were lost to follow-up. Survival analysis with Kaplan-Meier estimator showed significantly higher survival rates among females than males in WHO stage 1&2 and 3 (both P <0.0001) and borderline in stage 4 (P = 0.076). Cox model revealed a hazard ratio (males vs. females) of 1.70 (95% confidence interval, 1.35-2.15) after controlling for WHO clinical stages, body mass index, and age. Males had a higher rate of lost to follow-up than females in all different occupations except for health workers. **Conclusions:** The major reasons for a higher mortality in male patients starting ART may relate to their seeking for medical care at a more advanced stage of immunodeficiency and poorer compliance to therapy. The issue needs to be addressed in scaling up ART programs in Africa.

INTRODUCTION

Introduction of highly active antiretroviral therapy has greatly improved the survival outcomes of patients with AIDS, both in resource-rich countries [1-3], and resource-limited settings [4-11]. Since the World Health Organization (WHO) launched the "3 by 5" initiative of placing 3 million people in developing countries on antiretroviral therapy (ART) by the end of 2005, great strides have been made, particularly in sub-Saharan Africa where 1.3 million patients had started ART by December 2006 [12].

As expected, the baseline degree of immunodeficiency, measured either by plasma viral load, CD4-lymphocyte count or WHO Clinical Stage, is one of the most important risk factors for a high mortality [4, 6, 7, 13, 14]. Other risk factors include low body mass index and anemia [7, 14]. Before the introduction of ART, some cohort studies found no evidence of appreciable gender differences in disease progression either from seroconversion to AIDS or from AIDS to death [15]. Since the widespread scale up of ART, some studies have identified gender as an important factor in survival outcomes, although the finding may not be so consistent [8, 13, 14, 16-22]. We therefore decided to investigate the effect of gender on mortality in adult AIDS cases started on ART at Mzuzu Central Hospital (MCH), North Malawi, and look for the possible reasons.

MATERIALS & METHODS

Study Setting and management of ART

MCH is the main referral hospital in the northern region of Malawi, and through the Rainbow Clinic, it has been providing free ART to eligible HIV-infected cases since July 2004 in accordance with the national guidelines [23, 24].

When a patient is found to be HIV-positive, referral is made to the ART clinic for clinical staging. If the patient is found to be eligible for ART (assessed in WHO Clinical Stage 3 or 4 or with a CD4-lymphocyte count < 200/mm^3, if laboratory is available), he/she is asked to come with a guardian for a group counseling session about ART conducted by one of the staff of Rainbow clinic. All eligible HIV-positive cases undergo a thorough clinical assessment before starting therapy. Provided there are no contraindications, all cases are treated with a generic, fixed-dose combination of stavudine 30 mg (T30) or 40 mg (T40) / lamivudine 150 mg / nevirapine 200mg (procured from Cipla, Mumbai, India, under the trade name of "Triomune") in line with the Malawi national recommendations. Adults are also given cotrimoxazole preventive therapy (CPT) at the same time as ART according to the national guidelines.

Once started on ART and CPT, cases are followed up, first at 2 weeks and thereafter at 4-week intervals, with assessments and drugs distributed from the ART clinic. Characteristics and standardized treatment outcomes are recorded in ART treatment master cards and the ART registry on a regular monthly basis that has been previously described [24]. Treatment outcomes of HIV-infected cases receiving ART are classified into: (a) alive and on ART at MCH, (b) death, (c) lost to follow-up for more than 3 months (abbreviated as "default"), (d) stopped treatment, and (e) transferred permanently to another ART clinic. In the Rainbow clinic, an electronic information system using fingerprints is maintained to identify every case at the start of therapy and

during follow-up, and this has been useful in ensuring the correct identity of cases attending follow-up at the clinic [25].

Data collection and statistical analysis

Data were collected from the ART registry on all persons started on ART at MCH, and these included age, sex, date and reason for starting ART. The outcomes for cases alive and on ART were censored on December 31st, 2006. Adverse outcomes (death, treatment stop, lost to follow-up for more than 3 months and transferred out) were recorded with their dates up until the censor date of December 31st 2006. Data were entered and cleaned in EXCEL and analyzed with SAS statistical software (Version 8.2, SAS Institute Inc.; Cary, NC).

Survival analyses were conducted with Kaplan-Meier estimates and the log-rank test to compare the difference between different survival functions. We also constructed a Cox proportional hazard model to estimate the hazard ratios (HR) of mortality for the following prognostic factors: age (every 10 years interval starting from 15 years); gender (male, female); WHO Clinical Staging (Stages 1&2 with a CD4 count < 200 cells/mm^3, Stage 3, and Stage 4), body mass index (BMI <17, BMI 17-18.5 and BMI > 18.5). Results were presented as HR with 95% confidence intervals (CI).

Ethical approval

The Malawi National Health Science Research Committee does not require studies that use routine programmatic data collection to be formally submitted for ethical or scientific approval. As such, no formal submission for this study was made to the Research Committee. General measures were provided in the Rainbow Clinic to ensure patient confidentiality, consent for HIV testing, and support for children and guardians upon receiving a positive HIV test result.

RESULTS

Cases and survival rates

A total of 4001 individuals started ART at MCH between July 2004 and December 2006. Children (defined as a person < 15 years of age, n = 473) and cases who were transferred out to another site (n = 690) were excluded from further analysis. Of 2838 cases who started ART up to December 31st 2006, 2029 (71.5%) were alive and still on ART at MCH, 376 (13.2%) were dead and 433 (15.3%) were either lost to follow-up or had stopped therapy (Table 3-1). The survival rates of AIDS cases decreased as WHO stage advanced (85.0% in stages 1&2, 72.1% in stage 3, and 60.1% in stage 4). In contrast, patients with a higher BMI have better survival rates (Table 3-1).

Gender Difference

Among these 2838 AIDS cases, females had a significantly higher survival rate than males (76.0% vs. 64.6%; $P < 0.001$ in Table 3-1). This finding persists after stratification by WHO clinical stage, body mass index and occupation, as summarized in Table 3-1. Figure 3 shows the survival analysis by Kaplan-Meier method after stratification by gender and WHO clinical stage. Log rank test shows that female survival rates are significantly higher than those of males (P <0.0001 for stages 1&2 and stage 3 in Figure 3), but are only of borderline significance for patients in stage 4 (P = 0.076). According to the different quarters from when ART was started, females always showed significantly higher survival rates than males, apart from the most recent two quarters, July to September 2006 and October to December 2006 (data not shown).

Multivariate analysis using Cox proportional hazard model

After adjustment using Cox proportional hazard models, male gender, younger age, lower BMI, and advanced WHO clinical stages were significantly associated with increased mortality, as summarized in Table 3-2. Of these, patients in WHO stage 3 and stage 4 had the highest risk of death with HR of 2.52 (95%CI, 1.56-4.39) and 5.25

(95%CI, 3.18-9.27), respectively. There was a decreasing trend of HR from the younger to older age group (Table 3-2).

DISCUSSION

The WHO clinical stage and malnutrition are well-known important prognostic factors for AIDS mortality [7, 14], which corroborate the validity of this study, as summarized in Table 3-2. Although the effect of gender on mortality of adult AIDS patients is not a new issue, previous studies have not shown consensus or consistent results [8, 13-22]. Many of these studies have documented increased mortality in male AIDS patients [4, 13, 14, 18, 19, 21, 22], but some studies failed to show statistically significant results, probably due to a small sample size, a short duration of follow-up [8], or the lack of control of confounding factors such as the WHO clinical staging, nutritional condition and age. This study from Malawi, a resource-poor country in sub-Saharan Africa, has tried to clarify the effect of gender on mortality in patients started on ART by undertaking a more comprehensive analysis of the long-term follow-up of a cohort up to 30 months. And the result corroborates the existence of the effect of male gender after control of potential confounding by other risk factors. Thus, we tentatively concluded that males suffered from a higher mortality than females under the same ART regimen. But what is the major mechanism?

At the Rainbow Clinic, Mzuzu central hospital, females had a decreased "lost to follow-up" (default) rate compared with that of males (13.0% vs. 18.6%, Table 3-1), which is an indication of better compliance to therapy among females. As the main care-taker for children in the Malawian family, and possibly in other developing countries as well, females are usually more motivated to undergo voluntary counseling and testing (VCT) and to take ART regularly. In contrast, males may be more reluctant

to undergo VCT. This study also showed a statistically significant trend that distribution of WHO stages for males seeking ART for AIDS were more advanced than those of females (Table 3-1), as also found in other studies [26, 27], which would make them more vulnerable even under ART.

After stratification by the WHO staging, however, males still showed increased mortality. If further stratified by different occupations, the trend of a consistent lower survival among males persisted, except only for health workers, as shown on Table 3-1. Females had significantly higher survival rates than males both in the occupations with a higher socioeconomic status like businessmen and in the occupation with a lower socioeconomic status like farmer. Teachers, students, soldiers and police officers had the same trend, though not significant probably due to their small sample sizes. Only health workers had a similar rate for both males and females, probably because both genders had full awareness of the health impact of HIV/AIDS and much easier access to ART than general population. Moreover, there were also consistently higher rates of lost to follow-up of males among these occupations. Namely, the lost to follow-up rates for businessmen, farmers, and teachers in males vs. females were 12.3% vs. 9.4%, 16.2% vs. 7.6%, and 10.6% vs. 4.5%, accordingly. And that of the 635 housewives, all females, was 12.4% only, indicating a generally high compliance. Only people without definite occupations (n=1036) did not show a significant difference of the rates of lost to follow-up between males and females, i.e., 22.3% vs. 21.5%.

This result corroborates our hypothesis that males generally had a later start of ART and poorer compliance to such treatment, which may lead to the higher mortality, as were also reported in some other studies [8, 11, 28, 29]. Our previous study, putting extra efforts to determine the true outcomes of 253 patients “lost to follow-up” in the northern region of Malawi including our Rainbow Clinic at Mzuzu central hospital and other

three district hospitals, found that 127 (50%) of those "lost to follow-up" were dead, only 58 (23%) patients were assured alive after comprehensive home visits. [30] Since the higher rates of lost to follow-up of males were found across different occupations, it may imply to be related to a common cultural factor. According to our anecdotal observation and qualitative study, one of the major reasons for males to seek for medical care at a later stage and poorer compliance to ART may be related to their dignity in the Malawian culture. And attention should also be paid to those without definite employment, in which both genders showed a relatively poor compliance.

CONCLUSIONS

Gender difference was found to be a significant factor influencing survival and mortality in adult patients on ART in both univariate and multivariate analyses in this study. Males generally sought for medical care at a later clinical stage. The rates of survival and lost to follow-up of males are also worse than females across different occupations. Thus, we concluded that significantly higher mortality in male patients may be associated with their poor compliance to the ART, which may be related to their culture, such as the dignity of being a male. In order to improve the survival outcome, it is crucial to increase patients' access for earlier treatment and to improve the compliance of patients, especially among male adults and people without definite employment, in ART scaling up programs.

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The threshold of body mass index for early mortality of children on antiretroviral treatment: A five-year follow-up study in Malawi

ABSTRACT

Objective: In children receiving antiretroviral treatment (ART) to assess body mass index (BMI) as a prognostic indicator and to determine if there is any life-threatening level.

Design: An observational follow-up study at Mzuzu Central Hospital, Malawi.

Methods: Children under 15 years old starting ART between September 2004 and December 2006 were followed up until August 2009. Mortality was determined and risk factors were explored through the construction of Cox proportional hazards model.

Results: Among 505 children (263 boys), there were a total of 82 (16.2%) deaths. The receiver operating characteristic curves analysis indicated that the best predictability of child mortality was BMI measured at baseline and the first month. The Cox model showed that BMI $\leqq$ 15 kg/m^2 and WHO stage IV were two significant risk factors, both with three times greater risk of mortality. Furthermore, Kaplan-Meier survival analysis for the cohort stratified by the WHO staging and BMI showed that stage IV children did not have more death than other stages if their BMI were >15 kg/m^2.

Conclusions: BMI $\leqq$ 15 kg/m^2 is the life-threatening level of children on ART which can be a warning sign for early mortality. Nutrition assessment and intervention should be integrated with ART program from the beginning.

Running Head: BMI threshold for early death of children on ART

INTRODUCTION

Mzuzu Central Hospital (MCH) is the main referral hospital in the northern region of Malawi. It has been providing free ART to eligible HIV-infected children since September 2004 in accordance with the national guidelines for Malawi (1, 2). The prognostic risk factors for early mortality in these children with acquired immunodeficiency syndrome (AIDS) on ART for 3 and 6 months have been reported to be the advanced clinical stage and severe wasting (3).

Malnutrition is a common cause of morbidity in children with AIDS and growth failure is one of the most sensitive indicators of disease progression (4-13). In South Africa, more than 50% of HIV-infected children are underweight and stunted (13). Vice versa, there is a high prevalence of HIV infection in severely malnourished children (14-16). In Malawi, around 40% of children with malnutrition are found to be HIV infected (14). Though the association between malnutrition and AIDS was well-known, no clear cutoff value of any anthropometric parameter for children has been recognized or proposed to be the threshold for early mortality.

The aim of the current study was to follow up these children with AIDS on ART in order to assess body mass index (BMI) as a prognostic indicator, and to determine if there is any threshold of BMI for early mortality.

METHODS

Case assessment and management

All HIV-infected children, who were considered eligible for ART by World Health Organization (WHO) clinical or immunological criteria, underwent a thorough clinical and nutritional assessment before starting treatment. Children's guardians received pre-ART counseling and education about how to administer medications. The treatment protocol was in accordance with the national guidelines for Malawi (1-3). Treatment outcomes were classified into: (a) alive and on ART at MCH, (b) death, (c) lost to follow-up for more than 3 months, and (d) transferred permanently to another ART clinic. The outcomes were recorded with dates until the censored date of August 31st, 2009.

Once ART was started, children were followed up biweekly for the first month and then monthly, with assessments and medications distributed from the Rainbow ART clinic at Mzuzu Central Hospital. Body weight and body height were recorded at the beginning, the first month, and every 3 months when they came back to get medications. Basic demographic data including age, gender, initial body weight and height, date and reason for starting ART, WHO stages, treatment outcomes, compliance with clinic visits, and drug adherence have been monitored and recorded on an electronic information system on a regular monthly basis (17). Data were collected for all patients whose entry ages were less than 15 years while beginning ART.

Ethical approval

The Malawi National Health Science Research Committee did not request formal submission for ethical or scientific approval for studies using routine programmatic data collection. As such, no formal submission for the current study was submitted to the Research Committee. General measures were provided to ensure patients'

confidentiality. The consent for HIV testing and support for children and guardians upon receiving a positive HIV test result were provided as well.

Statistical analysis

The characteristics of children classified into 4 categories of BMI ($\leqq$13, 13-15, 15-17, and >17 kg/m^2) were compared using the Chi-squared test. Kaplan-Meier estimates and the Log-rank test were used to perform survival analyses in order to compare differences between different survival functions. We also constructed a Cox proportional hazards model to estimate the hazard ratios (HRs) of mortality for the following prognostic factors: age (0-1.5 years, 1.5-5 years and 6-15 years); gender (male vs. female); WHO stage (I & II, III and IV) and body mass index (BMI $\leqq$ 15 vs. > 15 kg/m^2). Results were presented as HR with 95% confidence intervals (CI). Receiver operating characteristic curves (ROC) analysis was performed to compare the area under the normalized ROC curve (AUC) for WHO stage and anthropometric indicators including weight, height, weight-for-height and BMI at the beginning, the first and the third month. Statistical significance was defined as a p value <0.05. Data analysis was carried out using the SPSS software (version 16.0 for Windows, Apache Software Foundation, USA).

RESULTS

Cohort characteristics

Between September 2004 and December 2006, there were 505 children aged less than 15 years starting on ART at Mzuzu Central Hospital. Among them, 263 (52.1%) were boys. Table 4-1 shows the comparison of the baseline characteristics of these children on ART classified into four BMI categories. The percentage of children with lower BMI, such as less than $\leqq$13 kg/m^2, was increased as WHO stage advanced and children who survived generally had higher BMI than deceased children.

Survival rates

More than two-thirds of the children were alive and still on ART at MCH by the end of the follow-up on 31 August 2009 (Table 4-1). A total of 82 children (16.2%) died, of whom 64 (78.0%) died within the first 6 months, 69 (84.1%) died within the first year, 80 (97.6%) within the second year of treatment. After the second year, there were only two deaths. The survival rates of children increased as the baseline BMI increased (Figure 4a) but decreased as WHO stages advanced. If the survival rates were further stratified by BMI categories ($\leqq$15 versus > 15 kg/m^2), the significant difference in the survival rate between different WHO stages was only shown in patients with BMI less than 15 kg/m^2 (Figure 4b and 1c).

Dynamic changes of BMI after ART

The comparison of the BMI of children at the beginning and follow-up visits stratified by both WHO stages and outcomes is summarized in Table 4-2. The children with WHO stage IV had lower BMI than those with WHO stage I-III and a significant difference in BMI between WHO stage IV and WHO stage I-III only showed at the baseline and the end of the first month, not at the later follow-up visits. If the BMI of children at the beginning and follow-up visits were stratified by outcomes as alive or

deceased, children who were alive had a higher average of BMI values than deceased children during the first three months of starting ART.

Cutoffs and area under the ROC curve of anthropometric parameters

The predictive powers for mortality within the 5-year follow-up for the anthropometric parameters, including weight, height, weight-for-height, BMI as well as the WHO staging were assessed by the area under the curve (AUC) of ROC analysis and are summarized in Table 4-3. The BMI and weight-for-height at the baseline and the first month were found to have a significantly discriminative ability to predict the mortality, which showed better predictability than WHO staging.

Cox hazard model

After adjustment using Cox proportional hazard models, we found that BMI $\leqq$15 kg/m^2 and WHO stage IV were two risk factors significantly associated with increased mortality, as summarized in Table 4-4. Children with a BMI $\leqq$15 kg/m^2 and WHO stage IV had about three times higher risk of death than those with a BMI > 15 kg/m^2 or in WHO stage I & II. There seems to be a decreasing trend of hazard ratio (HRs) from the younger to the older age groups. There was no difference between two genders or different orphan states.

DISCUSSION

The current study showed that the children with AIDS on ART had a 5-year survival rate of 67.7%. Most (97.6%) of the mortality occurred in the first two years of treatment. Through the construction of Cox proportional hazard model, we found that WHO stage and malnutrition were two significant prognostic factors for AIDS mortality, consistent with findings in previous studies (3, 6, 18-23). To our limited knowledge, the current study is the first one to demonstrate that BMI 15 kg/m^2 might be a potential life-threatening threshold for children with AIDS, despite effective antiretroviral therapy (ART).

Though WHO stage is a well-established prognostic indictor, our survival analyses showed that the significant difference only occurred in children with severe malnutrition, namely, BMI less than 15 kg/m^2 (Figure 4, b). The current study suggests that severe wasting may be a prerequisite leading to death of children with advanced clinical stage. Furthermore, we also found that BMI had a larger area under ROC curve, or predictive power, than WHO stage, shown in Table 4-3. Therefore, we recommend that BMI should be assessed for every child with HIV/AIDS.

The significance of BMI on predicting the mortality has been documented in previous studies regarding adult AIDS cases on ART, but the cutoff values for adults appeared at around 16-18 kg/m^2 (20, 22-24). As children generally have a smaller BMI than adults (25) and more than two-thirds (69.3%) of children's BMI were below 16 kg/m^2 in the current study, we conducted the ROC analysis and found that two cutoff values with the largest area under curve: BMI 14.7 kg/m^2 at the beginning and 15.3 kg/m^2 at the first month (Table 4-3). For easy understanding and memory, we used 15 kg/m^2 to represent these two cutoff values. Moreover, we further validated BMI 15 kg/m^2 as an independently significant risk factor of mortality in the Cox proportional

hazard model (Table 4-4).

In the current study, we found a general pattern of increase of BMI in children after starting ART even in severely ill children, shown in Table 4-2, which corroborates results from previous studies (6, 11). Though the average BMI of AIDS children with WHO stage IV was significantly lower than that of AIDS children with stages I-III at the beginning and the first month, they appeared to catch up the growth very soon. If the BMI of children at the beginning and follow-up visits were stratified by outcomes, the average BMI of living children were generally higher than deceased children at the first three months, but a statistically significant difference was not shown in later visits (Table 4-2). The average BMI of those patients who died before the next visit was always the lowest. It appears that the predisposing effect of malnutrition on mortality decreases by time. After the third month, some other reasons such as tuberculosis and/or opportunistic infections became more important than malnutrition to explain the mortality. This hypothesis was further supported by the ROC analysis in Table 4-3, which shows that all the area under the curves of all anthropometric parameters were decreased to a less significant level after the third month (Table 4-3). Therefore, we suggest that the first three months are the golden period to have nutrition assessments and early interventions, especially for severely malnourished children.

In Malawi, many children and their care-givers did not know the exact dates of birth of the children. So, it is less accurate to check the weight-for-age or height-for-age. In contrast, BMI and weight-for-height are more independent from age and can be easily obtained. In some resource-limited settings, both indicators have already used as inexpensive prognostic predictors in children with AIDS on ART (5). However, the BMI showed less variation during the follow-up period than weight-for-height. As BMI had a larger area under ROC curve than weight-for-height (Table 4-3), BMI may be a

better indicator than weight-for-height.

Gender and orphan states were not found to be significant prognostic factors in the current study. It may indicate at least an equal likelihood of adherence to ART in child patients (Table 4-4). The extended family system in Malawi is similar to that in other African countries (26). It appears that the system currently can cope with the orphan situation and does not discriminate against girls. We hope that adequate social and economic supports to children's caregivers can be continued in order to maintain their good compliance as well as adequate nutrition for these children (27).

Limitations

The current study has some limitations. First, we did not use the laboratory data as routine indicators because it was not available for every case in a resource-limited setting. Moreover, advanced WHO clinical stages are often associated with poor laboratory results such as low CD4 counts, anemia and thrombocytopenia. For example, one previous study in Malawi found that the anemia only occurred in patients with WHO stage IV (28). Another meta-analysis combined 13 cohort studies concluded that CD4 count at 6 months after starting ART, not at baseline, is associated with subsequent disease progression (29). Therefore, using CD4 count as a prognosis predictor may be inappropriate at the beginning. Secondly, there were 5.3% of patients lost to follow-up in the current study. Our previous study in the northern region of Malawi found that 50% of "lost-to-follow-up" were dead, and only 23% patients were assured alive after comprehensive home visits (30). Since we did not include those lost-to-follow-up children as deceased cases, we might slightly overestimate the survival rate in the current study.

Conclusions

A 5-year survival rate of 67.7% among 505 children with AIDS on ART was

documented in the current study. ART can improve the survival of children with AIDS, as well as catching up the growth in severely ill children. Since the impact of malnutrition on child mortality mainly happened within the first three months, the nutrition assessments and interventions should be started as early as possible. The current study also demonstrated that BMI can be an effective prognostic indicator for child mortality in a resource-limited setting. Children with BMI less than 15 kg/m^2 were at a significantly higher risk of early mortality. This life-threatening threshold can be a warning sign for clinical staff and caregivers to pay more attention to the severely malnourished children. We suggest that nutrition support should be integrated with current ART management for children with AIDS.

Abbreviations

AUC: Area under the ROC curve;

CI: Confidence interval:

WHO: World health organization;

ROC: Receiver operating characteristic;

SD: Standard deviation.

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Conflicts of interest: None.

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附錄二：

其他已經發表，本人為第一作者或共同作者的相關論文

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