



Global Development Network 1999 - 2009

GDN Working Paper Series

An Evaluation of a Safe Motherhood Hospital Program

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Working Paper No. 23

October 2009

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This Working Paper has been prepared within the GDN's Global Research Project *Promoting Innovative Programs from the Developing World: Towards Realizing the Health MDGs in Africa and Asia*. The project has been fully funded by the Bill & Melinda Gates Foundation, United States. The views expressed in this publication are those of the author(s) alone.

An Evaluation of Safe Motherhood Hospital Program

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Abstract

The Safe Motherhood Hospital program aims to improve maternal and child health and reduce mortality among mother and child. The program has been in place for 10 years, but there has been no impact evaluation of the program. In this research, we evaluate whether the program has an impact on maternal mortality and the cost of child delivery. The research use Propensity Score Matching (PSM) technique that widely used for non-experimental studies. PSM has been a popular approach to estimate causal treatment effects, particularly when evaluating labour market policies and social programs (i.e., Heckman et al. 1997; Dehejia and Wahba, 1999; Heckman et al. 1998b; Heckman and Smith, 1999). The technique is considered inexpensive and very useful for applying to evaluate public projects in Thailand where projects have been implemented without a prior design for impact evaluation. From our analysis, we find that number of changes of director of the hospital, geographic factors, size of catchment area, socio-demographic structure of the district and hospital resources are statistically significant determinants to SMH program participation both before 2004 and 2005. Using various weighting and matching methods, we find that the SMH program has no impact on the proportion to maternal death per child delivery. The program, however, can reduce cost (*i.e.* length of stay for birth giving and labour cost) of participating hospitals. Given that the program does not allocate more resources to the participating hospitals, its guidelines can reduce the cost of child delivery without increasing the death rate. This could be considered as a success of the program. The findings also show that the program also encourages referral. However, referral among community hospitals may be contaminated by the way the NHSO financed referral cases.

Acknowledgement

This research is under the umbrella of “Promoting Innovative Programs from the Developing World: Towards Realizing the Health MDGs in Africa and Asia.” The authors thank Global Development Network (GDN) and Bill & Melinda Gates Foundation for their financial support of this research. We also thank Thailand’s Ministry of Public Health, particularly the Department of Health, for their cooperation. Academic supports and comments from Jeffrey Smith and other participants at the workshops organized by GDN are highly appreciated. We are grateful to Lyn Squire and Ranjeeta Thomas for their hard-work on this research network and for their kind assistance to this research. We also thank the Rural Doctor Society for helping us conduct the hospital survey, particularly Dr. Kriengsak Vacharanukulkieti who wrote the Thai version of Appendix A. Special thanks are also due to our research assistants including Palita Pankhong, Bawornpan Ashakul, Patanayut Santiyanont and Suwimon Pakthong. The conclusions of this research do not represent views of organizations we work for. All errors are our own.

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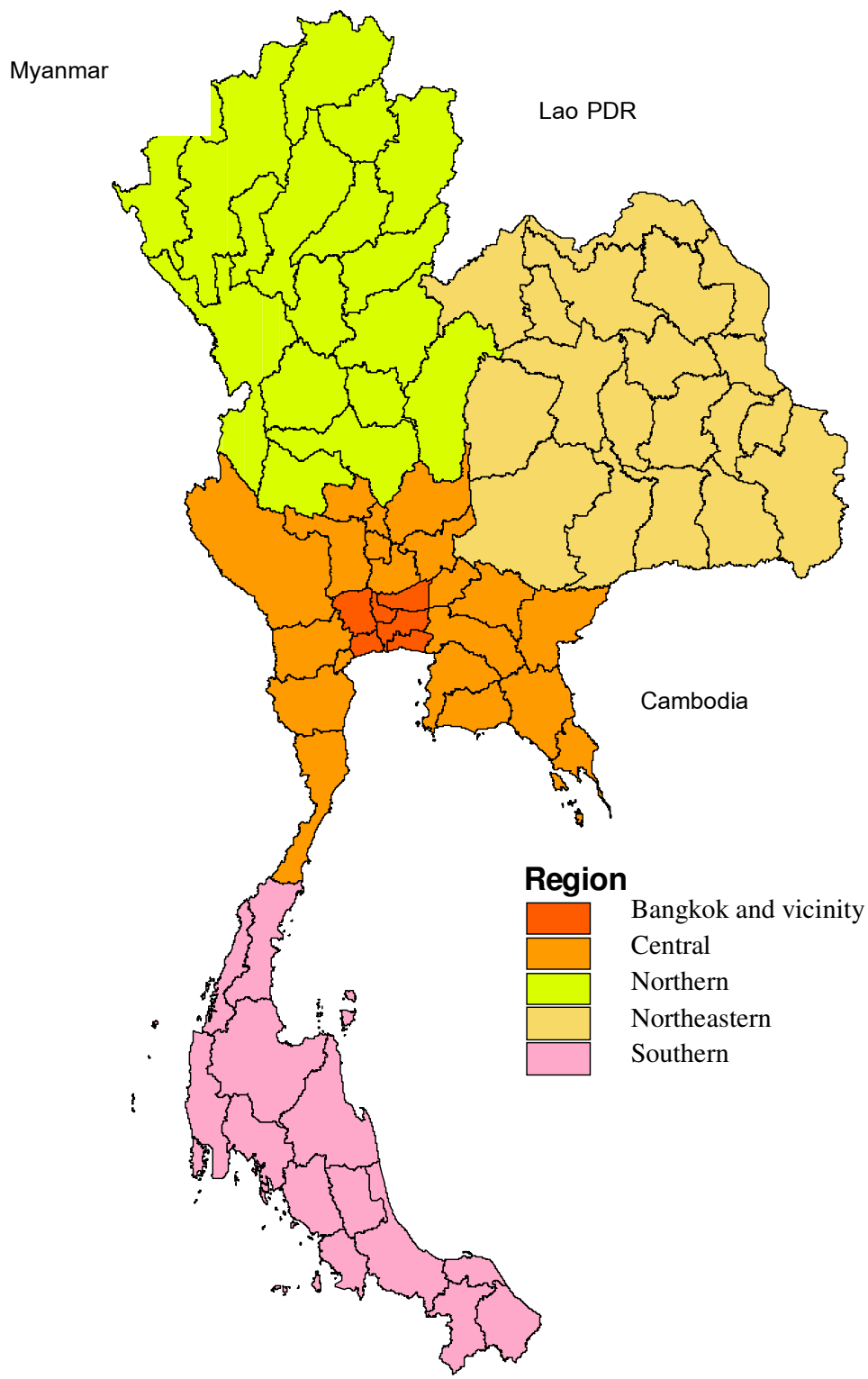
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I. Introduction

1. The Maternal Mortality Ratio (MMR) is one of indicators in the Millennium Development Goals (MDGs). The MDGs include eight ambitious goals to be achieved in 2015. They were set out as a global agenda to promote human development and reduce global inequalities. On the improved maternal health goal, Thailand has endorsed that the MMR would be reduced by three quarters between 1990 and 2015.

2. Thailand's Department of Health (DOH), Ministry of Public Health (MOPH) reported that the MMR in Thailand was at 36 per 100,000 live births in 1990. The ratio declined to 16.8 per 100,000 live births in 1995, but it jumped to 26.9 in 2000. The spike of this ratio could be due to inconsistent data collection or the adverse effect of the economic shock in 1997. The incidence has attracted serious attention from health care officers and international health networks. They have tried to monitor health care for mothers and children by initiating the Excellent Safe Motherhood Hospital Initiative, later called Safe Motherhood Hospital (SMH) program.

3. Two major problems on health care for mothers and children remain even though the program has been implemented for almost a decade. The first problem is reliability of data collection. It is hard for health care workers to follow the health status of mother and child in rural areas, where the number of health care workers per population is low. It is less likely that hospitals follow the health status of mother and newborn for 42 days (i.e. the length of time used to define maternal death). The report of death by a family member has not been traced back whether it was due to child delivery. Therefore, the statistics of MMR is believed to be lower than reality. It is shown in Chandoevwit *et al.* (2007) that the MMR from hospitals reported to the DOH is less than half of the evidence-informed estimate. The second problem is high variance of MMR across regions and provinces. In 2003, the DOH reported that the national MMR was 23.6 per 100,000 live births. But, in many provinces the ratios were very high, such as Mae Hong Sorn (263.3), Satoon (109.5), Narathiwat (83.7), Pichit (84.4) etc. (data from the DOH). In the center of Thailand, the MMR was much lower at 16.8. But in northern Thailand, it was 48.6. This might imply unequal access to health care facilities and quality of life of people across provinces and regions. There might also be other factors in question such as geography, culture, and economic factors that need to be tested.

4. To achieve improved maternal health goal, Thailand should at least have reliable statistics on maternal death and should have a clear policy direction. The SMH program could improve the quality of life of women and help Thailand achieve the MDG if it actually reduces maternal mortality in the country. However, after the program has been implemented for 9 years, there has been no impact evaluation of the program. An impact evaluation of the SMH on maternal death is, therefore, the main objective of this research. The program might also impact the costs of providing maternal care such as the labour cost for child delivery, the cost of hospital bed and the cost of referring. These expected impacts will also be included in our study. This research is expected to promote more discussion on a clear policy guideline to achieve the improved maternal health goal.

5. The research will use Propensity Score Matching (PSM) technique that widely used for non-experimental studies. PSM has been a popular approach to estimate causal treatment effects, particularly when evaluating labour market policies and social programs (i.e., Heckman *et al.* 1997; Dehejia and Wahba, 1999; Heckman *et al.* 1998b; Heckman and Smith, 1999). The technique is considered inexpensive and very useful for applying to evaluate public projects in Thailand where projects have been implemented without a prior design for impact evaluation.

6. The next two sections give brief background about Thailand's public hospital administration and implementation of the SMH program. The following section explains methodology and data used. The final two sections provide the results and conclusion.

II. Public Hospital Administration

7. In Thailand, the first and second levels of administrative division are province (*Changwat*) and district (*Amphur*). Almost every district has at least one public hospital called a **community hospital**.¹ A public hospital in the main city (*Amphur Muang*) of the province called general hospital. **General hospitals** are more advanced in terms of equipment and human resources. In some provinces, when their general hospital has been improved to have all kinds of specialist, it can become a **regional hospital**. In 2008, Thailand has 25 regional hospitals. These three types of public hospitals belong to the Office

¹ The second and third community hospitals in a district were usually initiated by people in the district, not by the MOPH. The initial investment was from a donation, not from the government budget. In 2007, Thailand has 795 districts, but 730 community hospitals.

of the Permanent Secretary, MOPH. (For details of hospital administration and financing see the appendix)

8. Each public hospital has a catchment area. In most case, it includes the physical boundary and population living in such boundary.² Each hospital is in charge of Primary Care Units (PCUs), the smallest health care unit located in every *Tambon*.³ The PCU does not have a full-time physician. Physicians from community or general hospitals may rotate their visit to some PCUs depending on the policy of their supervising hospitals. Almost all PCU do not perform child delivery. But, they have staff for antenatal and perinatal care.

9. In a province where there is a university teaching medical science, it also has a university hospital, which is comparatively more advanced than regional hospitals. The university hospitals are under the supervision of the Ministry of Education.

10. The Office of the Permanent Secretary of the MOPH has control over the Provincial Public Health Office (PHO). The PHO supervises public hospitals and takes care of all health related policies and issues in the province. Before 2001, the PHO had quite high authority in the province because the government budget to public hospitals was allocated through the PHO. But, after the health care reform in 2001, the government has allocated the budget to public hospitals through the National Health Security Office (NHSO),⁴ mainly based on the population in the hospital's catchment area.⁵ The role of the PHO has been reduced to controlling only a proportion of the government budget, *i.e.* the budget of prevention and promotion, outpatient referral and new hospital investments.

11. Besides control on government budget allocation, the Office of the Permanent Secretary, MOPH, can control human resource allocation. The office also has authority to move hospital directors and heads of PHOs from one province to another province or to the central office of MOPH.

12. Bangkok, the capital of Thailand, is different from other provinces. Its administration is under the Bangkok Metropolitan Administration (BMA) Act of 1975. Bangkok has 50 districts. There are 48 public hospitals (eight belong to the BMA) and 5 university hospitals. The BMA also provides mobile health care units and community hospital centres. Bangkok

² There is some exception for people living on the border of a district. Those people may have to be under the community hospital that is not in their own administrative district.

³ A Tambon is smaller than a district, but larger than a village.

⁴ This is a newly established independent organization after health care reform in 2001. The NHSO performs as a health care purchaser and MOPH performs as health care provider.

⁵ Approximately THB2,000 or US\$57 per head per year in 2007.

is also filled with private clinics and private hospitals. Many of the private hospitals are modern and target their services to a particular group, *e.g.* upper-income class Thais and international patients. Since Bangkok has its own health care administration and a unique combination of public and private health services, we do not include Bangkok in this study.

III. Safe Motherhood Hospital Program in Thailand

13. The worldwide movement of the Safe Motherhood Initiative was started in 1987. Thailand, in collaboration with World Health Organization (WHO), effectively took action on the initiative in 1988. At that time, the health of women before, during and after pregnancy had been a neglected issue.⁶ Acute care relating to infectious diseases and accidents was the major workload of the public hospitals. Deaths from pregnancy or giving birth were much lower compared to deaths from infectious diseases or accidents. Thus, the initiative was not an easy task for the MOPH to shift attention of health personnel towards mothers and newborns. As a start-up, the MOPH set up a three-step action plan to improve maternal and child health care.

- Step 1 is Awareness, 1988-1992. MOPH aims to improve awareness among health care workers about the causes of maternal mortality and still-births. This step encourages health personnel to save the lives of mother and newborn. It also aims to shift the attitude of routine mother and child care to care for life saving. Many meetings among health personnel were organized to analyze the causes of maternal, perinatal and infant mortality in Thailand.
- Step 2 is Emergent-change, 1992-1994. Hospital directors, academics and health care staff gather together to discuss their problems of providing maternal care. This step recommends ways to improve the quality of health care services to pregnant women and prioritize the problems and solutions for each area.
- Step 3 is Launching, 1995 and after. SMH is launched with technical assistances from WHO. The techniques such the Partograph, risk factors evaluation for pregnant women, self examination after child delivery, and a logbook are used.

⁶ In the past, if a mother died during childbirth, most Thais did not question the quality of health care treatment. It was something wrong with the mother, *i.e.* being too young, too old, or too weak, or luck, *i.e.* bleeding during the middle of the night.

14. In 1998, the DOH and the Office of the Permanent Secretary, departments under MOPH, together with the WHO initiated a two-year project called “Excellent Safe Motherhood Hospital Initiative.” At the beginning, only a small number of hospitals joined the program. Those advanced hospitals were expected to be the model for other hospitals. Two years after, the MOPH asked every hospital under their supervision to cooperate and implement the SMH program. The DOH, which is in charge of the SMH program, set an 11-step guideline for implementation as follows:

1. The director of the hospital adopts a policy to participate in the program.
2. The hospital provides training courses for staff concerning the standard of prenatal and post-natal care.
3. The hospital provides standard prenatal care.
4. The hospital provides prenatal care group training at least once for pregnant women and husbands/relatives.
5. The hospital must have standard child delivery services.
6. The hospital must provide standard service for newborns in the delivery room.
7. The hospital must provide standard postnatal care, i.e., group training on baby care, breast feeding, and family planning.
8. The hospital must provide standard care for newborns, i.e., vaccination, and training for baby feeding and health monitoring.
9. The hospital collects maternal, child delivery and newborn data and analyzes the data with health care personnel.
10. The hospital provides counseling services related to unwanted pregnancy and complications in child delivery.
11. The hospital should collaborate with other hospitals in providing documentation for monitoring prenatal and post-natal health care.

15. Together with the guideline, the DOH also provides a standard process and self-evaluation guideline (shown in the Appendix) to the hospitals. The DOH and Provincial Public Health Office worked together on the process evaluation. As of 2005, almost all of the provincial hospitals (except for two provinces) and more than half (about 63 percent) of all hospitals have successfully completed the process evaluation (Table 1).

16. By implementing the SMH program, the DOH has pushed hospitals to improve their health care services for mothers and children. The program is a tool to achieve indicators on health care for mothers and children set in the MOPH's Ninth Public Health Plan (2003-2006) and the Department of Health Plan (2005-2008). By the end of the MOPH's plan, Thailand should achieve the MMR to be lower than 18 per 100,000 Live Births, infant mortality ratio to be lower than 15 per 1,000 Live Births, and HIV prevalence among pregnant women to be lower than 1 percent.

17. It should be noted that the SMH is the policy of the MOPH. All hospitals under the supervision of the MOPH have to cooperate and help the MOPH achieve the target. There is no incentive for cooperation and no monetary penalty for not cooperating. Hospitals do not receive an additional budget for following the SMH guidelines. Budget allocation from the MOPH is not mainly based on activities, but rather on the size of the hospital. However, the MOPH still has the authority on health personnel allocation even after the health care reform.

18. The DOH has made maternal death a serious issue in every hospital. If there is a maternal death in a hospital, the Provincial Public Health Office and all public hospitals in the same province and neighboring provinces have to organize a confidential case conference and report to the DOH. The conference aims to find out the cause of death and to share the incident with other provinces. The DOH and health personnel will learn from the case and try to avoid similar cases in the future. The case conference process could be considered as non-monetary penalty to the hospitals where the maternal death occurred.

TABLE 1

IV. Methodology

19. The SMH program aims to improve maternal and child health and reduce mortality among mother and child. The program has been in place for 10 years, but there has been no impact evaluation of the program. In this research, we will evaluate whether the program has an impact on maternal mortality and the cost of child delivery. Since collecting data for infant mortality requires a longer period of time and infant deaths are normally under-reported and very difficult to trace back, we do not include an evaluation of how the program impacts infant mortality. Therefore, the outcome measure of the impact is the proportion of maternal mortality to total child delivery of the hospital and the cost per child delivery.

20. The SMH program will be evaluated at the community, general and regional hospital levels. Since the decision of SMH program participation must be that of the director of the hospital (as stated in step-1 in the SMH guideline explained in the previous section), we first provide a model for the decision.

Program Participation Decision

21. Let the decision of a hospital to participate in the program depend upon the net present value of the social benefit of providing health care to people in the community (NSB_i^*). The director of the hospital, who has authority and responsibility for all of the hospital's performance, will make the decision based on the present value of social benefit of participating in the SMH program (SB_i) and the present value of the social cost of participating in the program (SC_i). The director of the hospital will participate in the program if $NSB_i^* > 0$, where $NSB_i^* = SB_i - SC_i$. The program might benefit the health care of mothers and children when the hospital participates in the program. But with limited resources, it may incur costs to other types of patients. For example, if more nurses are allocated for maternal and child health care, other type of patients may have to wait longer before getting treatment and may get a shorter time for their consultation.

22. Social benefits and costs also include private (*i.e.* director of the hospital) benefits and costs. There might be some pressure from the MOPH or colleagues that makes the director of the hospital's private costs or benefits especially high or low. In a province where only one district hospital has not yet participated in the program, the hospital that has not yet participated may have peer pressure. This hospital may make the head of Provincial Public Health Office appear to have under-performed. As a result, the director (with pressure from outsiders) may give a very high value to his or her private benefits and thus participate in the SMH program. SB_i and SC_i may depend on many factors such as:

- director's characteristics, *e.g.* response to new policy or work experience;
- geographic factors, *e.g.* location of hospital, distance to referral hospital;
- socio-demographic structure of people in the community, *e.g.* proportion of fertile women or older population, proportion of farmers or blue-collar workers, ethnic minorities, migrant workers concentration, degree of urbanization, share of population in the agriculture sector, average level of education, family structure, main religion, and average earnings;

- availability of hospital's resources and infrastructure, *e.g.* number of health care workers, size of hospital, equipment facility of hospital; and
- capacity of the hospital, *e.g.* number of inpatients and outpatients, number of child deliveries, number of new antenatal care patients.

23. Let these factors be included in a vector X_i . Hospital i 's decision to participate in the program can be written as:

$$(1) \quad NSB_i^* = f(X_i)$$

We assume a linear function for NSB_i^* that is:

$$(2) \quad NSB_i^* = X_i\alpha + \varepsilon_i,$$

where ε_i is an error term with a standard normal distribution. NSB_i^* is unobserved, but we observed the participation of hospital i in the SMH program. Let D_i be one if hospital i participates in the program, and be zero otherwise:

$$(3) \quad D_i = 1 \text{ if } NSB_i^* > 0; \text{ and} \\ = 0 \quad \text{otherwise.}$$

The probability that a hospital participates in the SMH program is given by:

$$(4) \quad \Pr(D_i = 1 | X_i) = \Pr(NSB_i^* > 0).$$

With a standard normal distribution assumption of ε_i , we estimate (4) using a Probit model.

Mean Impact on Outcome of the Participants

24. To evaluate the impact of the program, we want to know the difference between the proportion of maternal mortality of the hospitals participating in the program (treatment group) and of the hospitals not participating in the program (comparison group). Let Y_i be a random variable representing an outcome indicator for the hospital i (*i.e.* a proportion of maternal mortality to total child delivery or labour cost per child delivery). Y_{0i} and Y_{1i} are outcome indicators for non-participating and participating hospitals, respectively. The mean impact of the program on the treated, what the literature calls the Average Effect of Treatment on the Treated (Heckman *et al.* 1997, Heckman *et al.* 1998b), ATET, is:

$$(5) \quad ATET = E(Y_{1i} | D_i = 1) - E(Y_{0i} | D_i = 1).$$

25. If the program has a positive impact on maternal mortality (*i.e.* it reduces the mortality rate), the value of ATET will be negative. However, estimation of ATET in the above equation encounters selection bias. This is because program participation is not random. The director of the hospital decides to be in the treatment group when NSB_i^* is positive. An additional problem with the calculation is that we only observe one of the outcomes (*i.e.* $E(Y_{1i} | D_i = 1)$). To correct selection bias, we will estimate the counterfactual mean outcome of participating hospitals. That is, we want to estimate the average outcome of participating hospitals if they were not in the program ($E(Y_{0i} | D_i = 1)$).

26. We assume that conditional on covariates X_i which are not affected by participation, program participation is independent of the outcome of treatment and comparison groups. This implies that we observe all variables (*i.e.* director's characteristics, geographic factors, socio-demographic structure of people in the community, availability of hospital's resources and equipment, and performance of the hospital) that influence the program participation decision and potential outcomes simultaneously. This assumption is referred to as "unconfoundedness" or "conditional independent" (Rosenbaum and Rubin, 1983; Lechner, 1999). However, Heckman *et al.* (1998b) note that it is only necessary to assume conditional mean independence for the non-participants (*i.e.* $E(Y_{0i}|X_i, D_i = 1) = E(Y_{0i}|X_i, D_i = 0)$) to estimate the average treatment effect on the treated.

27. Rosenbaum and Rubin (1983) show that if outcomes are independent of participation conditional on covariates X_i , then they are also independent of participation conditional on the propensity score $P(X_i)$. In our application, the propensity score is the probability of participating in the SMH program given observed characteristic X_i , or $P(X_i) = \Pr(D_i = 1 | X_i)$ estimated from equation (4). Given that conditional independent assumption holds and $\Pr(D_i = 1 | X_i) < 1$, the propensity score matching estimator for ATET is

$$(6) \quad ATET = E_{P(X_i)|D_i=1} \{E(Y_{1i} | D_i = 1) - E_Y(Y_{0i} | P(X_i), D_i = 0)\}.$$

28. Under the conditional independence assumption, exact matching on $P(X_i)$ eliminates all biases due to selection into the program based on observable variables (Imbens, 2004). After obtaining $P(X_i)$, we will match non-participating hospitals that have similar probabilities of participating in the SMH program. Matching is based on selection on observed variables. Matching acts like random assignment because it balances the observable of the participants and comparison groups.

29. We use the following general form of the matching estimator (*e.g.* Heckman and Smith, 1999).

$$(7) \quad \text{ATET}(S) = \sum_{i \in (D_i=1)} [Y_{1i} - \sum_{j \in (D_j=0)} w_{n_0, n_1}(i, j) Y_{0j}] \text{ for } P(X_i) \in S,$$

where Y_{1i} and Y_{0j} denote outcome indicators for participant i and non-participant j , respectively, n_0 is the number of non-participating hospitals (comparison hospitals), and n_1 is the number of participating hospitals. $w_{n_0, n_1}(i, j)$ is the weight attached to comparison hospital j in constructing the counterfactual outcome for participant i . The sum of the weights for each i equals one. The set S is the common support of $P(X_i)$. In this study, we define the common support by dropping treatment observations whose $P(X_i)$ is higher than the maximum or less than the minimum $P(X_i)$ of the comparison hospitals. Moreover, each participant is also matched by using a weighted average over comparison hospitals for sensitivity analysis. The Caliper matching, Kernel matching and local linear matching with various bandwidths are used.

V. Data

30. The primary source of data is from a hospital survey conducted by the author and her associates between September 2007 and April 2008. We started by sending questionnaires to 837 public hospitals under the supervision of the MOPH (Table 2). With four months of follow-up including telephone calls and hospital visits, we obtained an 86 percent response. Six of them are far from complete and are deleted from the analysis sample.

31. Figure 1 depicts the responding hospitals in each district. There are 18 districts with more than one MOPH hospital in 2006. We delete these hospitals from our sample because there are two or three hospitals that share similar district-related covariates. However, there is only one maternal death outcome in each district and we cannot tell which hospital dominates the outcome. We also delete Health Promotion Centres from our sample because they used to be special health centers for maternal and child health care. They did not take part in the SMH as implementators, but as evaluators. The recent reform in the DOH made some of them stop providing child delivery services. Two community hospitals are deleted because the capacity of one of them is so low that it does not provide child delivery and another of them opened in 2006 (the year that we evaluate the SMH impact). The final

sample size is 677 hospitals, composing of 600 community hospitals, 58 general hospitals, and 19 regional hospitals.

TABLE 2

FIGURE 1

32. Additional secondary data are collected from the Community Development Department, Ministry of Interior. The data represent the socio-demographic structure of each district. They include the number of villages and household explaining the size of district. They also include the proportion of women and of age group in the population which might be able to explain the decision of the director of hospital about the focus of hospital services. Other variables included are the proportion of students and the proportion of the labour force with different education levels, the proportion of villages with lower and upper secondary schools and the proportion of household member participating in different economic activities. Table 3 shows descriptive statistics for the variables used. Lists of variables are in Appendix C.

TABLE 3

TABLE 4

33. From our survey, 57 hospitals have not yet passed DOH evaluation (Table 4) which is based on monitoring indicators shown in Appendix B. About 28 percent passed evaluation after the program has been implemented for five years. Another 34 percent have just passed the evaluation in the past three years. Figure 2 shows the year in which each hospital in the districts passed evaluation. A large proportion of hospitals in the North and South passed evaluation in 2006 and South in 2003-2004, respectively. In the Northeast, many of the hospitals passed evaluation in 2001, 2002, and 2005. A hospital seems to pass evaluation in the same year as their neighboring hospitals.

34. A typical problem with recording the number of maternal death arises when we conduct the hospital survey. The number of maternal deaths counted from the questionnaire was too low. From the interviews with hospital staff, we find that Thai health care staff do not correctly understand the definition of maternal death. In this study, we use the definition

defined by the tenth revision of the International Classification of Diseases (ICD-10). That is a maternal death is the death of a woman while pregnant or within 42 days of the termination of a pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by pregnancy or its management, but not from accidental or incidental causes (WHO, 2004)

35. Chandoevrit *et al.* (2007) used civil statistics and inpatient records to calculate the number of maternal deaths in 2004-2006. The guide for such a calculation is shown in the Appendix D. We will use the number of deaths from that study in stead of the number obtained from the hospital surveys. The following table shows that, of all the districts in our sample, the reported number of deaths (95) is less than half of the evidence-supported number (225). All types of hospitals under-report their maternal deaths. Seven of regional hospital replied to the survey that they have no maternal deaths in 2006. But, the data show that only one of them has no maternal death in the same year.

36. It should be noted here that our outcome indicator differs from the MMR. We do not include mothers who gave birth without visiting a hospital. We include those giving births on the way to visit a hospital. The maternal death in this study omits births without a hospital visit. This omission is not serious since approximately 93 percent of births in 2005 and 2006 were delivered in hospitals.⁷ We use the proportion of maternal death to total child delivery as an outcome indicator. The denominator of our outcome indicator differs from that uses in the MMR definition. One might call our outcome indicator as “case fatality rate.”

FIGURE 2

TABLE 5

VI. Results

Program Participation

37. Table 4 and Figure 2 show that hospitals start participating in the program differently across year. In our analysis, we use two measures of program participation; whether the hospital has participated before 2004 and whether hospital has participated before 2005. We choose these two years because the program has been implemented long enough to have more

⁷ From birth registration database.

hospitals involved to have tentative impacts. About 44 percent of the sample passed process evaluation before 2004 and about 57 percent of the sample passed process evaluation before 2005. Recent years of program participation such as participation up to 2006 or 2007 may not be good to estimate because almost all hospitals have participated and outcome indicators are measured for year 2006. From the interview, we find that evaluation in recent years is not as serious as in the earlier period as policy makers have shifted their attention to newer policies. This might dilute the impact of the program.

38. SMH program participation is the decision of the director of the hospital. Factors that are expected to have effects on the director's decision and on the outcomes of the hospital are grouped into four categories: director's response to MOPH policies, geographic and health facilities in the district, district's socio-demographic structure and hospital resources, capacity and infrastructure. Results for program participation among full sample and community hospital sample are presented in Tables 6 and 7. For each sample set, the results before the balancing test and after dropping variables that do not pass the balancing test are presented. Method used for balancing test is shown in Appendix E.

TABLE 6

TABLE 7

Director and his/her response to policy

39. Considering that hospitals in Thailand are crowded with patients, new policies from the MOPH could be burden. Some directors might want to get promoted and moved to a more developed provinces, as such they might respond quickly to the MOPH policies. Some directors, on the other hand, might have their own priorities and might not respond to a new policy that is not one of their own priorities. The new policy might not address a major health threat in their catchment area. Variables that may represent a director's response to MOPH policies are whether the hospital passes hospital accreditation (HA) evaluation, whether the hospital has SMH policy or announces the SMH policy to their staff, and whether the staff of the hospital have the chance to participate in any training in the past six months.

40. Other variables that might indicate response to policy are number of changes of hospital director and work experience of director. If the hospital has changed director many times in the past ten years, it implies that such hospital is not a good place to work. The

director may not have enthusiasm for work and may not care about improving health care conditions of their catchment area. In this case, the director will be less likely to participate in the SMH program. On the other hand, work experience of the director may increase the possibility of SMH participation as experience may teach him/her to manage hospital and to control the additional burden caused from new policy.

41. The results show that, from the beginning of the SMH initiative to 2003, the number of changes of hospital director has a negative effect on SMH participation among the community hospitals (Table 6). A director with more years of work experience is more likely to participate in the program before 2005 (Table 7). Other variables are not statistically significant determinants of program participation.

Geographic and health facilities in the district

42. Geographic and health facilities in the district and socio-demographic factors may help the hospital director evaluate the social benefit from participating in the SMH program. The distance of the hospital to a referral hospital might increase program participation because the SMH program encourages networking and early referral. The number of private hospitals may have a negative effect on program participation as doctors and nurses are more likely to practice in private hospitals. In this sense, they would have less time to devote to public health policy. However, if the director of the hospital wants to compete with private ones, he/she might improve hospital performance and participate in the SMH program. The proportion of population in catchment area per doctor or per nurse may have a negative effect on program participation. Hospital staff tend to have high workload when the proportions of population to doctor or to nurse are high. At the same token, if the hospital has to take care of population in many villages, it might also less likely to participate in the SMH program. There might also be geographic differences in how hospital directors manage hospitals.

43. The results for program participation before 2004 and 2005 are quite similar. Hospitals in the south are more likely to participate in the SMH program. When the size of district is large, *i.e.* a larger number of villages in the catchment area, or a high proportion of population per nurse, the director of the hospital is less likely to participate in the program. Hospitals in the northeast are more likely to participate in the program before 2004.

Socio-demographic structure

44. Population size and the gender and age structure of the district may also affect program participation. If there are more females in the fertile age group in the district,

population in the district will need more mother-child health care services. The director may see this public need and improve the hospital services to respond to their need. This will increase likelihood of program participation.

45. Factors such as education, religion and occupation may also have impacts on the director's participation decision. Highly educated and high income society tends to concern better health cares. People with high education or who work in the formal sector (non-agricultural sector) tend to have fewer children. They may spend more time on perinatal care and be more concerned about mother-child care services. The director might perceive this and act in favor of this population. Thus, he/she will be more likely to participate in the SMH program.

46. Tables 6 and 7 show that the director is more likely to participate in the program if the proportion of females to total population is high and the average household size is large. Large household size may imply a growing population in the district which require health care for mothers and children. On the contrary, with a higher proportion of elderly, it is less likely that the hospital will participate in the program. The hospital may allocate more resources for health care for elderly, not maternal care.

47. If the proportion of private employee is high, it is less likely for the community hospital to participate in the program. Thailand has three public health care schemes: Civil Servant Medical Benefit Scheme (CSMBS), Universal Health care Coverage Scheme (UC) and Social Security Scheme (SS). Private employees are under the SS scheme which they pay monthly contribution. They have an option of choosing a registered hospital. In most case, they choose good services and equipment hospitals that tend to be general or regional hospitals in the city, not community hospitals. This behavior may discourage the community hospitals to focus their services for private employees.

Hospital resources, capacity and infrastructure

48. Hospital resources might encourage the hospital director to participate in the SMH program or might limit the hospital's ability to participate. If hospital have many doctors, gynaecologists or other specialists and nurses and all the necessary equipment, it is easy to participate in the program. On the contrary, if such human and physical resources are limited, the hospital will have a difficult time allocating the resources required to join the program. It is not likely that hospital will get more specialist or gynaecologists after program participation since the program has not design for more human resource allocation. The

program is under the DOH which has no authority of resource allocation to the public hospitals. Budget, income, the number of new antenatal patient, and the number of inpatients and outpatients indicate the size of the hospital. The large values of these variables imply high capacity of the hospitals which might allow them to participate in many MOPH-promoted activities like the SMH program. We do not expect that the program participation can influence these variables as budget is allocated based on population in the catchment area. Moreover, pregnant women do not choose hospitals from whether or not they are in the SMH program. Areas of resident of pregnant women determine which public hospital they should visit since most of them are under the UC health care scheme. The scheme does not allow eligible population to choose hospital. The UC scheme covers about 80 percent of population.

49. The results show that these variables do not pass the balancing tests and are dropped out from the program participation equations. Some of them are statistically significant determinants of the program participation. For example, the number of bed is statistically determined program participation since it implies the size of hospital and usually relates with how well the hospital is equipped.

50. Figures 3 and 4 show the distributions of propensity scores using results from Tables 6 and 7. The propensity scores are used for matching and ATET estimation. For program participation before 2004, the estimated propensity scores distribute nicely between 0 and 1. After dropping variables that do not pass the balancing test, the distribution of propensity scores of non-participants have not changed significantly. However, for the participants, the density of propensity scores in the approximation of one is higher.

51. The propensity scores of participant community hospital have high density in the area close to one, for both program participation before 2004 and 2005. However, after dropping variables that do not pass the balancing test, the propensity scores distribute more evenly between 0.4 and 0.7.

FIGURE 3

FIGURE 4

Mean Impact on maternal death

52. Tables 8 and 9 show the mean impact of the SMH program on the number of maternal deaths based on program participation estimated in Tables 6 and 7. We use two indicators; total maternal death in the district per child delivery x 1,000 and maternal death taken place in the hospital per child delivery x 1,000. With different weights and matching method, we find that the SMH program has no impact on the proportion of maternal death to child delivery. The result is not surprising as the program does not allocate more resources to participating hospitals. Moreover, from the interview to hospitals in every region,⁸ many of the directors of the hospitals did not anticipate that the SMH program can reduce the number of maternal death. They think that the program set the guidelines for standard maternal and child cares. The guidelines have improved the quality of care, but do not reduce the number of maternal death. The directors and nurses reported that the causes of maternal death were mainly hemorrhage and hypertension. In many cases, pregnant women did not have antenatal care. As the result, they did not know that they were in the high risk of maternal death.

53. From the interview, we also find that hospitals do not follow the 11-step guidelines (shown in Appendix B) set by the DOH seriously even after passing the process evaluation. For example, doctor-nurse ratio for child delivery should be 1:3 as stated in step 5th. But, almost all of the hospitals use two nurses for natural child delivery. Sometimes some hospital used only one nurse.

54. To monitor women after 42 days of birth giving is not an easy task for a hospital. It does not matter whether the hospital has passed the program evaluation or not. We find from the interview that women who work as unskilled labour are more likely to move between big city (*e.g.* Bangkok) and their home provinces. When they are pregnant, they do not have time for prenatal care. They like to give birth in their hometown and have their mother taking care of the newborns. If they have high risk of miscarriage or death, the hospitals do not have a chance to monitor both before and after birth giving.

55. People who live in mountainous areas, particularly in the border of Thailand and Myanmar have quite difficult time to access to hospital in the city. Some villages have no road. Pregnant women have to walk for eight hours before getting a truck to the hospital that takes more than four hours. To rent a truck to the hospital costs too much. These women are,

⁸ We interviewed one regional hospital, one general hospital and five community hospitals in each region during the same period as the questionnaire interview. Interviewees were directors of the hospitals or nurses in child delivery room or nurses in the antennal care unit.

therefore, less likely to have antenatal care. A doctor said that a pregnant woman is at risk of death if she lives in the mountainous area and coincidentally wants to give birth while it is raining. It is more difficult and takes more time to travel from the village in mountainous area to the hospital while raining. The possibility of death is extremely high if she has hemorrhage. The doctor called this kind of maternal death as “classical case.” The SMH program has no aspect of reducing the classical case.

TABLE 8

TABLE 9

TALBE 10

TABLE 11

TABLE 12

TABLE 13

TABLE 14

Mean impact on cost

56. The cost outcomes include cost on length of stay for birth giving (Table 10), labour cost (Tables 11), costs of referring in and out (Tables 12 and 13). The labour cost includes the cost of doctors and nurses used for each child delivery. As we do not know the unit cost of nurses and doctors in the hospital, we use the number of nurses and doctors used to represent a labour cost index. Since cost for a doctor should be higher than a nurse, we convert doctor cost into doctor-nurse equivalent cost. We assume two cases for converting, *i.e.* a case where one doctor is converted to 1.5 nurses (Table F1) and a case where one doctor is converted to 2 nurses (Table 11). Total doctor-nurse equivalent cost is summed to the labour cost index.

57. The results from Table 10 shows that the SMH program before 2004 reduces length of stay for birth giving when we use single nearest neighborhood, five nearest neighborhood, and caliper matchings. However, the impact of program participation before 2005 on length of stay for birth giving is not statistically significant.

58. After dropping variables that do not pass the balancing test, we find that program participation reduces the labour costs for child delivery when we use single nearest neighborhood and caliper matching. (Tables 11). For community hospital, the program has an impact on labour cost when we used log linear regression matching. This cost index is quite sensitive to weight and matching used.

59. The average impacts of program participation on referred in and out is quite significant among community hospitals participating in the program before 2004 (Tables 13 and 14). The program increases referred in cases and decreases referred out cases of participating community hospitals. Networking and referring among hospitals are the standard processes for steps 10th and 11th of the SMH program (shown in Appendix B). Program participation encourages community hospitals to refer high risk pregnant case to general or regional hospitals or community hospitals that have more specialists and equipment. It also encourages general hospitals to refer difficult birth giving cases to regional hospitals. When referral was made at an early stage of pregnancy, the risk of losing life would be lower. If a high risk pregnancy cases do not have antenatal care, the detection of high risk pregnancy will occur at the time of labour. Referral as an emergency case has a high probability of maternal death.

60. It is quite surprising from the results that community hospitals refer pregnant women among the community hospitals only. We expect that the full sample should have the same results as the community hospital. The phenomena probably can be explained by the new system of financing the referral case. Thailand started its Universal Health Care Coverage in 2001. The way the hospital is financed has reformed significantly as explained in section II. However, because of the administrative problem about money transfer between hospitals, many hospitals did not want to admit referral patient. In addition, the cost of referral was unable to settle. Such behavior was serious and policy makers solving this by setting the rule for referral payment (see Appendix B). For the inpatient, the refer-out hospitals do not bear any referral cost. The refer-in hospitals receive additional payment through the Diagnosis Related Groups (DRGs) system. This may encourage the community hospitals to refer patients among themselves.

V. Conclusions

61. The SMH program was initiated to improve mother and child health care. As maternal mortality is one of the indicators of maternal health, we evaluate the impact of the program on maternal death. From our analysis, we find that number of changes of director of the hospital, geographic factors, size of catchment area, socio-demographic structure of the district and hospital resources are statistically significant determinants to SMH program participation both before 2004 and 2005. Using various weighting and matching methods, we find that the SMH program has no impact on the proportion to maternal death per child

delivery. The program, however, can reduce cost (*i.e.* length of stay for birth giving and labour cost) of participating hospitals. Given that the program does not allocate more resources to the participating hospitals, its guidelines can reduce the cost of child delivery without increasing the death rate. This could be considered as a success of the program. The findings also show that the program also encourages referral. However, referral among community hospitals may be contaminated by the way the NHSO financed referral cases.

62. From the hospital interview that was taken in 2007, we realize that many of the hospital staff did not know whether their hospital passes process evaluation. The old staff moved to other hospitals and the new staff came in. The nurses in delivery room like the SMH program in the sense that it sets a guideline for maternal care. When the new nurses are in action, they can follow the same guideline. If the guideline is followed seriously, we can consider that it is the success of the program. Some hospitals choose to follow the guideline causally.

63. In our study we do not focus on how serious the process evaluation was taken. We admit what has been evaluated by the DOH and the Provincial Public Health Office. We also admit that the quality of process evaluation could vary across provinces depending upon the standard of the Provincial Public Health Office. Even though the DOH set a guideline for such evaluation, discretion is unavoidable.

64. It is hard to evaluate why the program has no impact on the proportion of maternal death to child delivery. The finding is quite consistent with the view of the directors of the hospital about the program impact on maternal death. The program has its own advantage as we find in this study. However, if we could go back to 1998, many of program implementation steps should have changed or improved. Policy makers should have been more serious about implementation and evaluation. Process evaluation should have been done by an independent institution, instead of the DOH or Provincial Public Health Office. The guideline for data collection and report system should have been set. It should have been clear to the hospitals that what would be the reward or punishment applied to them if they passed or did not pass the evaluation. These should be the lessons for other countries with quite similar health care setting with Thailand when they want to implement the SMH program.

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Appendix A

Brief Explanation of Hospital Administration in Thailand

In Thailand, there are 2 types of health care providers.

1. **Private Health care Providers:** Most of them are for profit. There are 2 types of private health care providers.

1.1 Private clinics for outpatients: The patients are treated by physicians who may also work in public hospitals. These clinics are located in Bangkok and big cities. There are 16,800 clinics in which 3,687 of them are in Bangkok.

1.2 Private hospitals: There are 344 private hospitals with 35,806 beds. 102 hospitals with 15,500 beds are in Bangkok.

Those private health care providers operate under the control of Medical Registration Division, Department of Health Services Support, Ministry of Public Health.

2. **Public Health care Providers:** They are not for profit and can be classified as follows.

2.1 Bangkok Area

1) There are 5 hospitals belonging to School of Medical Science. They are under the supervision of the Ministry of Education. The hospitals have high standards and have all kinds of specialists.

2) There are 29 general hospitals under the supervision of the Ministry of Public Health (5 hospitals), the Ministry of Interior (5 hospitals), the Ministry of Defence (7 hospitals), the Bangkok Metropolitan Administration (8 hospitals) and the state enterprise (4 hospitals).

3) There are 19 specialized hospitals and institutions.

4) There are 61 Bangkok Health Centers and 82 branches of community hospitals (10 beds), operate under Bangkok Metropolitan Administration. They act like primary health care units.

The hospitals in 1), 2) and 3) also act like referral center for Bangkok health centers, and hospitals in the other provinces.

2.2 Regional Area

1) There are 7 hospitals belonging to the School of Medical Science. They are under supervision of the Ministry of Education.

2) There are 25 regional hospitals (provide general health services) under supervision of the Ministry of Public Health.

3) There are 40 specialized hospitals under supervision of the Ministry of Public Health.

Most of the regional hospitals are located in main districts. They usually have at least 500 beds, with all kinds of specialists. They are the referral center for General Hospitals in the same region.

2.3 Provincial Area

1) There are 69 general hospitals locating in main cities. They are under supervision of the Ministry of Public Health.

2) There are 57 military hospitals under supervision of the Ministry of Defence. These hospitals have approximately 200-500 beds. They also act as referral center for community and general hospitals within provinces.

2.4 District Area

1) There are 730 community hospitals (covering 90% of the districts) under supervision of the Ministry of Public Health.

2) A public organization hospital, Banphaeo Hospital, Samut Sa-khon, is under supervision of the Ministry of Public Health.

3) There are 214 Municipality Health Centers acting as primary care units. They belong to Local Administration Organization.

These hospitals and health care centers serve primary health care services by physicians, dentists and public health care officers. They have 10-150 beds taking care of at least 10,000 populations in their catchment areas.

2.5 Sub-District (*Tambon*) Area.

There are 9,765 health centers, covering all *tambons* (some *tambons* can have more than one health center). Most of them are served by Non-Para Medicine. All health centers are supervised by District Public Health Offices (which are directly supervised by Provincial Public Health Physicians).

2.6 Village Area

1) There are 311 community health service centers.

2) There are 66,223 community primary public health centers in rural areas. They are set up in remote areas where access to public health care center is low. Each center takes care of 500-1000 populations.

3) There are 3,108 community primary public health centers in urban area. These centers provide health promotion, diseases prevention, primary care.

The MOPH owns about two-third of public health care units in Thailand. The hospitals are concentrated in urban areas. This results to unequal access to health care services among rural and urban population.

In 2001, Thailand had a health care reform, a universal health care coverage, that trying to improve access to health care services to all population. The reform has changed financing of public health care. The government has aimed to improve primary health care units to be able to provide holistic and comprehensive cares.

The Role of Provincial Public Health Office

The Provincial Public Health Office is under supervision of the Office of Permanent Secretary which is the largest department in the MOPH. The main role of the office is to supervise regional, general and community hospitals, and health and community health service centers. They also have to follow the public health policies from the ministry and control hospitals to act according to the policies. The head of the Provincial Public Health Office are physicians. The Provincial Public Health Physicians take care of allocating budget and other resources to health care units in their provinces.

Before the health care reform, budget is allocated into five items.

1. Health care treatment for low-income persons and disadvantaged groups. Mostly are expenses on medicine and medical supplies. Budget for this item was quite limited.

2. Labor Cost. This is directly allocated by the central office. The central office takes care of all labor costs of the MOPH's hospitals. This makes it easier for large hospitals in the city to expand their services. They can attract more health care workers to work in the city as a result.

3. Capital Fund. The size and allocation of the fund are changes according to the politic. Four years before health care reform, the capital investment was low due to the economic crisis.

4. Management cost. This includes utilities.

5. Budget according to department's policies.

After the health care reform, the financing mechanism has changed. MOPH becomes a health care provider and National Health Security Office (NHSO), a newly established public organization, becomes a health care purchaser. Budget for health care services from the government is allocated to NHSO on a capitation basis. Each population is registered to a nearby hospital and gets free health care treatment from such hospital. NHSO purchases health care services from the hospitals and makes payment according to the following three items.

1. Outpatients fund and fund for health promotion and prevention. Payment is made directly from the NHSO to hospitals that provide services according to the number of registered population in their catchment areas. The payment includes services from health centers in the same catchment area. This means hospitals and health centers in the same catchment area have to share the same capitation budget for outpatient treatment.

2. Inpatient fund. After the hospitals provide inpatient care, they can reimburse from NHSO based on Diagnosis Related Groups (DRGs).

3. Investment fund. About 10 percent of health care services budget are used for replacement investment.

The financing mechanism reform reduces the budget allocation power of the MOPH and Provincial Public Health Office. The capitation payment also includes labor cost which may have the effect on human resources allocation of the hospital between rural and urban areas. The hospitals in the rural area usually cover more population, but used to get lower budget allocation.

Expenditures in case of Referral System

Patients get free medical treatment when the registered hospital refers them to a higher level hospital that may or may not locate in their province. The expenditure resulted from referring depends on the types of treatment.

- For outpatient treatment, the referring hospitals have to pay to the referred hospitals. In some provinces, the Provincial Public Health Offices act as a clearing house by pooling some money from the public hospitals in the province.
- For inpatient treatment, the referring hospitals do not have to make any payment to the referred hospitals. The referred hospitals get payment from the NHSO based on DRGs.
- For emergency care and care for accidental patient outside the registration province, the hospital where the patient is admitted can request the reimbursement from the NHSO.

Appendix B

Self-evaluation of the SMH program

Rules	Standard process	Tools/Monitoring
1. Director of the hospital adopts a policy to participate in the program.	<ol style="list-style-type: none"> 1. The hospital has a written document about program participation. 2. The policy must cover all the 11 procedures of becoming a Safe Motherhood Hospital. 3. Chief division/department must be able to explain the policy to every personnel. 4. The hospital has a development process to become a Safe Motherhood Hospital. 5. The hospital has a committee monitoring hospital services. 	<p><u>Tools</u></p> <ul style="list-style-type: none"> - The hospital has policy labels at least two points at the registry, reception, ANC, or waiting area. - All related personnel know about the policy - The hospital conduct a meeting to explain the policy and allow staffs to attend maternal and child health care training course - The director of the hospital appoint a specific committee to monitor the services <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Observing - Interviewing - Reviewing reports/document - Reviewing appointed document
2. The hospital provides training courses for staffs concerning the standard of prenatal and post-natal care.	<ol style="list-style-type: none"> 1. The hospital promotes the safe motherhood program by improving the quality of services. 2. The hospital has activities to improve service quality for safe motherhood. 3. All related staffs are trained to provide the maternal and child care. 3. Staffs must be able to analyze the cause of death and improve the maternal and infant mortality situation. 4. The hospital has a team designing problem solving plans. 5. Staffs provide services wholeheartedly and speedily. 	<p><u>Tools</u></p> <ul style="list-style-type: none"> - Staffs participate in academic training and conference on maternal and child care or training on how to improve services on maternal and child care. - Staffs understand principle of management and quality control. - Staffs can identify causes of maternal and infant mortality and learn how to take care of those causes. - Staffs can identify names of those who are in maternal and child consulting team/committee - Patients are satisfied with quality of health care services. <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Recording staff training participation in a roster. - Interviewing. - Observing and reviewing the document.
3. The hospital provides standard prenatal care.	1. Staffs examine pregnant women who expose to potential risks	<p><u>Tools</u></p> <ul style="list-style-type: none"> - The hospital has diagnostic

Rules	Standard process	Tools/Monitoring
	<p>2. Staffs screens pregnant women using 20 risk factors</p> <p>3. Staffs encourage pregnant women to visit the hospital for prenatal care 4 times before giving birth.</p> <p>4. Staffs train pregnant women how to breastfeeding.</p> <p>5. Pregnant women have blood test for Anemia, Syphilis and Hepatitis B.</p> <p>6. Pregnant women are voluntarily tested for HIV/AIDS.</p> <p>7. Pregnant women are checked by an obstetrician visit at least once during their prenatal care.</p> <p>8. Staffs used logbook every times pregnant women visit the hospital.</p> <p>9. Pregnant women get tetanus vaccine.</p> <p>10. Pregnant women receive vitamin and iron supplement from the hospital.</p>	<p>rooms and tools, e.g. weight and height scale, measuring tape, blood pressure monitor, stethoscope, urinary glucose/protein test strip.</p> <ul style="list-style-type: none"> - The hospital displays 20 risk factors in the diagnostic rooms. - The hospital has a hygiene training room. - The hospital provides prenatal care and delivery card with patient's medical record and appointment. - The hospital has a place where doctor can diagnose patients. - Staffs use logbook every time pregnant women receive care, vitamin and iron supplemented at the hospital. - Staffs understand risk factors that cause maternal and perinatal mortality. - Staffs identify the causes of maternal and perinatal mortality. - Monitoring - Observing from OPD card, maternal logbook. - Interviewing.
<p>4. The hospital provides prenatal care group training at least one-time for pregnant women and husbands/relatives.</p>	<p>1. The hospital provides group discussion/training programs. Every pregnancy woman attends a discussion/training program. The hospital encourages husbands /relatives to attend the program. The program should provide;</p> <ul style="list-style-type: none"> - Maternal logbook instruction, - Maternal care during pregnancy, - The importance of 4 prenatal care visits, - Training/Discussion place, - Training schedule, - Instruction for husbands/relatives, - The importance of tetanus vaccine, - Preparation for breastfeeding, - Self-health attention during pregnancy, - Potential risks during pregnancy, 	<p><u>Tools</u></p> <ul style="list-style-type: none"> - The hospital has a place/corner for hygiene group training. - The hospital has a training kit. - The hospital has a training schedule. - The hospital provides document or manual. - The hospital has questionnaire for interviewing pregnant women about the training. - Staffs ask pregnant women whether they understand the practice during pregnancy <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing.

Rules	Standard process	Tools/Monitoring
	<ul style="list-style-type: none"> - Sexual Transmitted Disease (STD), and - The importance of obstetric appointment. 	
<p>5. The hospital must have a standard child delivery services.</p>	<ol style="list-style-type: none"> 1. Staffs use Partograph. 2. The hospital has life resuscitation equipment including; <ul style="list-style-type: none"> - Laryngoscope and Blade set, with spare battery, - Endotracheal tube size 28-35, sterilized and ready to use, - Ambu Bag, - Connectors, - Oxygen tank and equipment, - Rubber mask, - Medicine and tool card, and - Adrenalin, Sodium bicarbonate 3. The hospital has a life resuscitation team. 4. The hospital has resources to provide Cesarean section or has referral facility in case the C-section is needed. 5. The hospital has a blood bank or blood bank network. 6. The hospital has doctor-nurse ratio of 1:3 for each delivery. 	<p><u>Tools</u></p> <ul style="list-style-type: none"> - The hospital has a partograph in mother's medical record. - Staffs are trained and able to use partograph. - The hospital provides schedule for life resuscitation team in the delivery room. - The hospital provides consultation team for complicated delivery. - The hospital has referral reports/systems. - Staffs in the delivery room know whereabouts the blood bank services. - The hospital displays the number of doctor and nurse per one case of delivery. <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing.
<p>6. The hospital must provide a standard service for newborns in delivery room.</p>	<ol style="list-style-type: none"> 1. Staffs monitor body temperature. 2. Staffs monitor breathing. 3. Staffs prevent Infection. 4. Staffs provide eye drop. 5. Staffs provide Vitamin K injection within two hours after delivery. 6. Staffs promote breastfeeding in delivery room. 7. The hospital has facility and staffs for newborn cardiopulmonary resuscitation including; suction (-80 to -100 mm. Hg.), sterilized bulb syringe, oxygen flow meter, connector for trachea, oxygen mask or tubing, laryngoscope, and endotracheal tube for infant. 8. Staffs know how to take care of special-case infants. 	<p><u>Tools</u></p> <ol style="list-style-type: none"> 1. The hospital has Body temperature control including: <ul style="list-style-type: none"> - Room temperature controlling with thermometer, - Kits for warm temperature for infants such as heater, yellow light bulb, and blanket, - Wind or cooling control near newborn baby, - Bathing control in delivery or operating room, - Body temperature check. 2. The hospital has a respiratory care system including: <ul style="list-style-type: none"> - Facility and equipment for newborn cardiopulmonary resuscitation, - Staffs for newborn cardiopulmonary resuscitation. 3. The hospital has infection protection such as hand basin and wash liquid and disposable towel. 4. The hospital provides non-expired eye drops and vitamin K in

Rules	Standard process	Tools/Monitoring
		<p>specific places.</p> <p>5. The hospital has a counseling team to provide appropriate care for special case infants. The team should regularly attend standard training.</p> <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing. - Examining schedule.
<p>7. The hospital must provide a standard postnatal care.</p>	<p>1. The hospital provides training to mother including;</p> <ul style="list-style-type: none"> - Instruction on post-natal health care such as cleanliness, and observing unusual condition that requires doctoral attention, and vaccine, and - Knowledge regarding STD and birth control. <p>2. The hospital promoting breastfeeding by explaining;</p> <ul style="list-style-type: none"> - Advantages of breastfeeding, and - Breastfeeding steps (infants should be breastfed for at least 4 months). <p>3. Staffs promote family-planning by;</p> <ul style="list-style-type: none"> - Appoint mother for medical check-up, - Teach birth control technique. 	<p><u>Tools</u></p> <p>The hospital:</p> <ul style="list-style-type: none"> - interviews mother regarding practice and activities after child delivery, - record the number of trained participant, - has place/room for group training, - has pamphlet or suggestion note fro mother, - has plan for hygiene training, - has appointment card/ logbook for mother, - interviews mother about staff suggestions, - interviews mother about birth control technique, and - provides document to mother. <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing. - Reviewing document. - Reviewing training schedule.
<p>8. The hospital must provide a standard care for Newborns.</p>	<p>1. Newborn gets Tuberculosis and hepatitis B vaccine injection.</p> <p>2. Newborn stays with mother and is fed from breast only.</p> <p>3. Staffs have closed monitoring of body temperature, respiration, suckling, excreta, infection, and jaundice within 48 hours.</p> <p>4. The hospital can refer special case newborn and mother to another hospital safely.</p>	<p><u>Tools</u></p> <p>The hospital:</p> <ul style="list-style-type: none"> - provides new born diary (mercury form), - has medicine in the specified place, - provides instruction to mother on newborn vaccination, - has staff who can explain about the post-natal care, - has infant service equipment (as in procedure 6), - has staff who can identify unusual case and refer to an appropriate place, - has referral data collection, - can identify referral place and contact persons. <p><u>Monitoring</u></p>

Rules	Standard process	Tools/Monitoring
		<ul style="list-style-type: none"> - Interviewing. - Observing. - Reviewing document.
<p>9. The hospital collects maternal, child delivery and newborn data and analyzes the data with health related staffs.</p>	<ol style="list-style-type: none"> 1. The hospital collects data on every case of maternal and perinatal mortality. 2. Staffs use the data to analyze the cause of death and plan how to prevent such causes. 3. Staffs have case conference on maternal and perinatal mortality. 4. Staffs conclude and present the analysis to the hospital executives 5. The hospital together with other hospitals in the province analyze maternal and perinatal mortality annually. 	<p><u>Tools</u></p> <p>The hospital:</p> <ul style="list-style-type: none"> - has data collection (forms A-1 and A-2), - uses data to analyze and develop problem solving plans, - has plan for academic conference, - has minutes of hospital meeting, - has resolution plan from the meeting with staffs in ANC, LR, PP, and NS divisions, - Staffs explain three causes of maternal and perinatal mortality to relatives. <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing. - Reviewing document.
<p>10. The hospital provides counseling service related to unwanted pregnancy and complications in child delivery.</p>	<ol style="list-style-type: none"> 1. Staffs provide advise in case of complication of maternal and child health. <ul style="list-style-type: none"> - Staffs must have knowledge on mother and neonatal infant care, - Staffs must know about referral systems and network. 	<p><u>Tools</u></p> <p>The hospital:</p> <ul style="list-style-type: none"> - has counseling team on maternal and child care, - has are for counseling services, - has training program for those providing counseling services, - specify how to contact the counseling team in/off office hours. <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing. - Reviewing document.
<p>11. The hospital should collaborate with other hospitals in providing document for monitoring prenatal and post-natal health care.</p>	<ol style="list-style-type: none"> 1. The hospital assigns staff to take care of mother and newborn referred cases. 2. The hospital assigns staff to follow the referred cases. 	<p><u>Tools</u></p> <p>The hospital:</p> <ul style="list-style-type: none"> - has statistics about mother and newborn available upon request, - gives follow up card to patients, - has referral card/form, - has referral network in the document. <p><u>Monitoring</u></p> <ul style="list-style-type: none"> - Interviewing. - Observing. - Reviewing document.

Source: Department of Health.

Appendix C

Table C1 List of variables in Stata data file

Variables	Description
1. Director and his/her response to policy	
ha	pass HA evaluation
policy	hospital has SMH policy
annou	director announces SMH policy
train	staff attend training
cdir	have changed director since 1998
expdi	no. of year director's been practising
2. Geographic and health facilities in the district	
northe	northeast
north	north
south	south
village	no. of villages in the district
referd	distance to referral hospital
privd	distance to the nearest private hospital
npri1	no of private hospitals in the district
npri2	no. of private hospitals in the province
npcu	no. of primary care unites in the catchment area
catch	population in catchment area /10,000
popdoc	population in catchment area per doctor / 10,0000
popn	population in catchment per nurse / 10,000
3. Socio-demographic structure	
house	no. of households in the district / 1,000
member	household size
p_area2	population in Tambon Administration Organization
female	proportion of female
f1549	female age 15-49
a60	proportion of age 60+
rel2	proportion of islamic population
v_g9	proportion of villages with lower secondary school
v_hs	proportion of villages with upper secondary school
grade1	non-students with lover secondary education /population
grade2	non-students with upper secondary education / population
grade3	non-students with diploma degree / population
grade4	non-students with higher education / population
h_agri	proportion of households with a member working in agricultural sector
h_work	proportion of households with a member working as private employee
h_own	proportion of households owning a business
4. Hospital resources, capacity and infrastructure	
newhos	hospital opened after 1995
doc	no. of doctors excluding gyn-ob
gyn	no. of gynaecologists and obstetricians
anesd	no. of anaesthetist
tech	no. of other healthcare workers and technical staff
othp	no. of other staff
ndoc	total no. of doctors in the hospital
nnur	total no. of nurses in the hospital
bed	no. of beds
icu	no. of ICUs
defib	no. of defibrillators

Variables	Description
resp	no. of respirators
ultas	no. of ultrasound machines
ekg	no. of EKGs
uc06	budget allocated from government in 2006 (100 mil. Bth)
inc06	income generated in 2006 (100 mil. Bth)
outpat	no. of outpatients / 10,000
inpat	no. of inpatients admitted/ 10,000
anc	new antenatal patients / 1,000
child	total child deliveries / 1,000
comh	community hospital (1=yes)
5. Outcome of hospitals and other variables	
hdi	maternal death in hospital / child delivery x 1,000
di	maternal death in the district / child delivery x 1,000
clos	length of stay for birth giving
reout	no. of pregnant women referred out
rein	no. of pregnant women referred in
reoutpc	no. of pregnant women referred out per 10 child delivery
reinpc	no. of pregnant women referred in per 10 child delivery
nndeli	no. of natural child delivery
nndoc	no. of doctor used during natural child delivery
ndnur	no. of nurses used during natural child delivery
utdeli	no. of child delivery using helpers (non-normal case)
utdoc	no. of doctors used during non-normal child delivery
utnur	no. of nurses used during non-normal child delivery
csdeli	no. of birth by c-section
csdoc	no. of doctors used during c-section
csnur	no. of nurses used during c-section
clos	length of stay for birth giving
nlive	no. of live birth
nneod	no. of neonatal death
nstillb	no. of still birth
nlowb	no. of low birth weight
md_dist	no. of maternal death outside hospital in 2006
md	no. of maternal death in and outside hospital in 2006
mdq	no. of maternal death assessing from questionnaire
di	maternal death / child delivery x 1,000
hdi	maternal death in hospital / child delivery x 1,000
laborc15	labour cost per child delivery (1.5 nurse equivalent)*
laborc2	labour cost per child delivery (2 nurse equivalent)*

Note:

laborc15 = (((ndnur+1.5*nndoc)*nndeli)+((utnur+1.5*utdoc)*utdeli)+((csnur+1.5*csdoc)*csdeli)) / (nndeli+utdeli+csdeli)

laborc2 = (((ndnur+2*nndoc)*nndeli)+((utnur+2*utdoc)*utdeli)+((csnur+2*csdoc)*csdeli)) / (nndeli+utdeli+csdeli)

Table C2 Mean test between participant and non-participants

Variable	Program participation before 2004			Program participation before 2005		
	Participant	Non-participant	mean test p-value	Participant	Non-participant	mean test p-value
ha	0.9077	0.9076	0.9980	0.9166	0.8959	0.4453
policy	0.9932	0.9815	0.1854	0.9947	0.9761	0.0355
annou	0.9932	0.9683	0.0235	0.9947	0.9590	0.0012
train	0.9832	0.9683	0.2198	0.9869	0.9590	0.0213
cdir	1.6610	2.0633	0.0287	1.7786	2.0273	0.1775
expdi	17.4068	13.7773	0.0000	16.4960	13.9058	0.0003
northe	0.3859	0.3298	0.1303	0.3541	0.3549	0.9832
north	0.1778	0.2875	0.0009	0.1875	0.3071	0.0003
south	0.2248	0.1266	0.0007	0.2786	0.0273	0.0000
village	92.2558	76.2672	0.0000	85.6292	80.2500	0.1603
referd	71.2516	57.9551	0.0044	68.1979	58.0546	0.0302
privd	46.1191	50.6965	0.1768	50.8567	45.8310	0.1388
npri1	0.3590	0.1002	0.0000	0.2708	0.1399	0.0156
npri2	3.0067	3.5620	0.0251	2.8489	3.9317	0.0000
npcu	13.5100	11.1424	0.0000	12.8229	11.3481	0.0060
catch	8.5930	5.5369	0.0000	7.6488	5.8773	0.0115
popdoc	1.0942	1.2253	0.0243	1.0967	1.2605	0.0049
popn	0.1051	0.1164	0.0897	0.1049	0.1200	0.0230
house	10.8797	8.5150	0.0000	10.0940	8.8492	0.0053
member	3.9686	3.8928	0.0080	3.9808	3.8544	0.0000
p_area2	4.1077	3.1379	0.0000	3.8099	3.2429	0.0009
female	0.5115	0.5100	0.0561	0.5103	0.5113	0.1829
f1549	0.2862	0.2850	0.2763	0.2861	0.2849	0.2975
a60	0.1143	0.1164	0.2875	0.1128	0.1191	0.0016
rel2	0.0696	0.0548	0.3211	0.0973	0.0140	0.0000
v_g9	0.6598	0.6542	0.6059	0.6550	0.6587	0.7347
v_hs	0.1903	0.1861	0.5254	0.1914	0.1834	0.2316
grade1	0.4716	0.4718	0.9817	0.4669	0.4780	0.2837
grade2	0.0511	0.0510	0.9598	0.0522	0.0496	0.2976
grade3	0.0238	0.0220	0.0898	0.0233	0.0222	0.2915
grade4	0.0166	0.0156	0.1766	0.0163	0.0157	0.3912
h_agri	0.6679	0.6603	0.6197	0.6755	0.6482	0.0742
h_work	0.3466	0.3606	0.1668	0.3372	0.3771	0.0001
h_own	0.0718	0.0734	0.8411	0.0643	0.0837	0.0154
newhos	0.0067	0.0395	0.0066	0.0104	0.0443	0.0051
doc	13.2852	6.0686	0.0000	10.9036	7.0716	0.0084
gyn	1.2751	0.3905	0.0000	0.9973	0.4948	0.0014
anesd	0.3825	0.1029	0.0001	0.2916	0.1399	0.0298
tech	16.7516	10.2770	0.0000	15.1302	10.5017	0.0001
othp	146.2013	93.3957	0.0002	134.3958	93.3686	0.0044
ndoc	14.9429	6.5620	0.0000	12.1927	7.7064	0.0071
nnur	115.9664	59.4089	0.0000	98.8515	65.2389	0.0004
bed	124.9228	58.7124	0.0000	104.7552	65.7099	0.0003
icu	3.8489	1.0897	0.0000	3.0442	1.3344	0.0111
defib	2.8389	1.9920	0.0037	2.4947	2.1945	0.3061
resp	7.0268	2.1767	0.0000	5.4166	2.8634	0.0202
ulta	1.5167	1.2506	0.0031	1.3854	1.3447	0.6524
ekg	4.4832	2.7308	0.0012	3.7864	3.1296	0.2276
uc06	0.3976	0.2421	0.0000	0.3536	0.2541	0.0053

Variable	Program participation before 2004			Program participation before 2005		
	Participant	Non-participant	mean test p-value	Participant	Non-participant	mean test p-value
inc06	1.0189	0.4766	0.0000	0.8580	0.5278	0.0039
outpat	12.3128	8.1683	0.0000	10.9488	8.7394	0.0018
inpat	0.9799	0.5266	0.0000	0.8407	0.5760	0.0012
anc	0.6713	0.4209	0.0000	0.6018	0.4385	0.0002
child	1.0376	0.5067	0.0000	0.9008	0.5301	0.0000
hdi	0.2621	0.2769	0.8214	0.2766	0.2622	0.8258
di	0.3435	0.3437	0.9979	0.3611	0.3206	0.5786
clos	2.4350	2.5151	0.1801	2.4552	2.5122	0.3416
laborc15	2.5976	2.4352	0.0666	2.5621	2.4340	0.1488
laborc2	2.8048	2.6193	0.0732	2.7640	2.6183	0.1604
rein	96.8389	18.2506	0.0000	72.9531	26.4880	0.0026
reout	46.6767	49.7625	0.4152	52.2480	43.3856	0.0192
reinpc	0.2900	0.0091	0.0000	0.0232	0.0108	0.0027
reoutpc	0.1174	0.1726	0.0000	0.1364	0.1639	0.0192

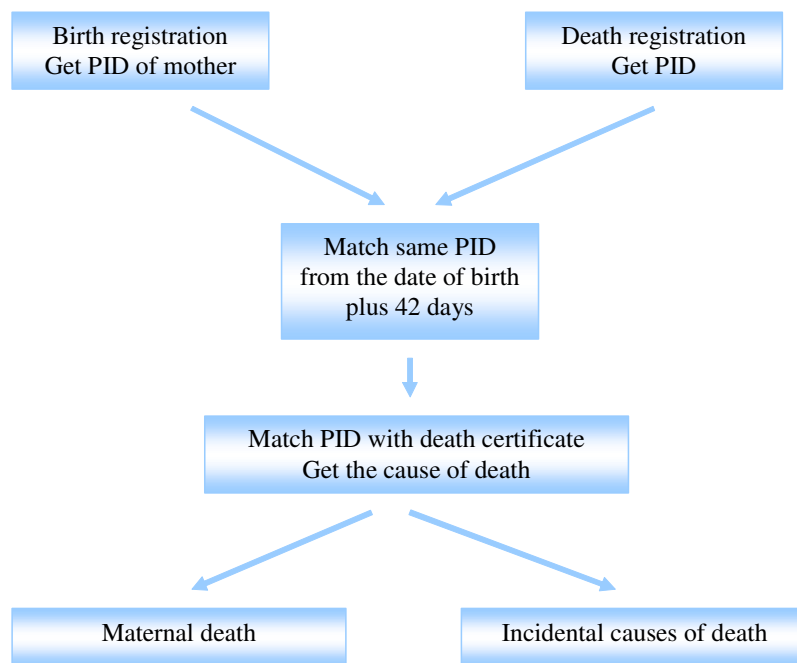
Appendix D

A Guide to Calculating the Number of Maternal Death

This guide follows Chandoevrit *et al.* (2007) (http://www.tdri.or.th/library/quarterly/text/s07_2.pdf). Basically, data from civil registration, birth and death certificates and inpatient record are linked using Personal Identification Number (PID) to count the number of maternal death. The PID is issued by the Ministry of Interior to every Thai when they were born. All of documentation about Thai used the same PID for official records.

We used three steps to calculate the number of maternal deaths. The first step counts the number of mothers who died after giving live births (Figure D1). We link the PID of mothers of the newborns to PID of reproductive-aged dead women. We know the date of birth of newborns and date of death of women. We keep only the record of those who died within 42 days of birth giving. From death certificate, we know the cause of death. We exclude those who died because of accident, suicide, or crime. The remaining records are potential maternal death after giving live births.

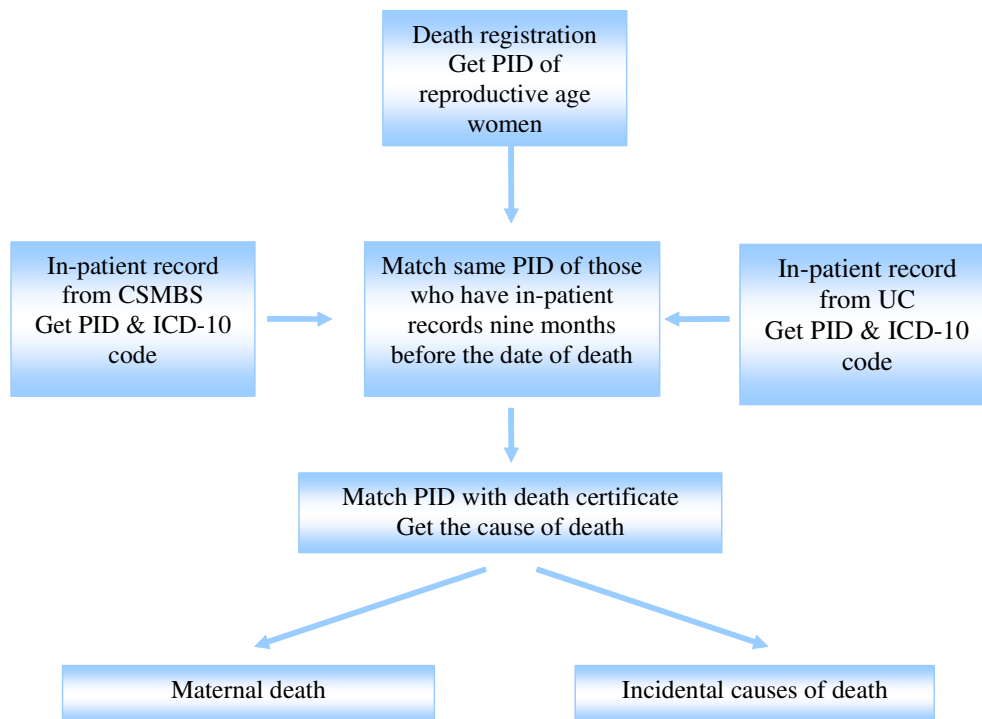
Figure D1 Count the number of mothers who died after giving live births



The second step counts the number of pregnant women who died without giving a live birth (Figure D2). We use inpatient record of two public health care schemes; Civil Servant Medical Benefit Scheme (CSMBS) and Universal Health care Coverage Scheme (UC); that cover about 86 percent of population. In this case, we miss those who died in private hospitals. About 85-90 percent of births were given in public hospital.

The PIDs of dead reproductive-aged women are matched with PID in inpatient records between the date of death and 270 days (9 month) before the date of death. About 35 percent of dead reproductive-aged women have no inpatient record with public hospitals. The matched records are kept if their ICD-10 code contained the code O00-O99 (pregnancy, childbirth, and the puerperium). Then we investigate each record that remained. The records that contain treatment relating to injury and poisoning of external causes, accident, intentional self-harm, assault, or event of undetermined intent and legal intervention and operation of war are excluded. Then, we exclude those who died after 42 days of discharge from the hospital because we are not certain about the cause of death.

Figure D2 Count the number of women ending pregnancy without a live birth



The last step is to integrate remaining records from step one and two. There is some overlapping between two steps because they start from the same number of PID. We drop

double counting. The number of maternal death in 2006 is 330 deaths that make MMR of 41.6. This figure is about double of the hospital report to the DOH. It should be noted that this figure is the minimal number because we miss some of those death in private hospitals. Some number on the last line of Table D1 might also be maternal death.

Table D1 Number of maternal death in 2006

	2006
No. of death: women aged 15-49	27,934
No. of live births	793,623
Step 1	
Maternal death	185
Incidental causes of death	18
Step 2	
Maternal death	250
Incidental causes of death	19
Overlapping of Method 1 and Method 2	
Maternal deaths	105
Incidental causes of death	12
Step 3 (Step 1 + Step 2 - Overlapping)	
Maternal death	330
Classified by health care scheme	
- UC	235
- CSMBS	15
- Others ²	80
Incidental causes of death	25
MMR (per 100,000 live births)	41.6
Pregnant inpatients that died between 42 and 270 days after being discharged from the hospitals. They are excluded because of uncertain cause of death.	174

Source: Chandoevrit *et al.* (2007)

To investigate further who under-report the number of maternal death as shown in Table D2. Since we know the districts of death, we group the death records into district. We disaggregate the deaths into death in hospital and death outside hospital. The district records are linked to the hospital survey. It should be noted that in our working sample, we keep only district with one response hospital (677). The following table shows that the report figure (95) is much lower than our calculation even among the death in the hospitals (152).

Table D2 Compare the calculated maternal death with the number reported from hospitals

No. of death in each type	No. of Hospital in each category			
	Community hospital	General hospital	Regional hospital	Total
1. Data from survey	Death in and outside hospital			
0	584	32	6	622
1	17	10	3	30
2	1	10	4	15
3	1	4	1	6
4	0	0	3	3
5	0	0	1	1
6	0	1	0	1
Total hospital	603	57	18	678
Total number of death	22	42	31	95
2. Data from Chandoev wit (2007) include all maternal death in the district where hospitals located	Death in and outside hospital			
0	515	20	1	536
1	74	20	3	97
2	7	13	6	26
3	4	2	5	11
4		1	1	2
6		1		1
7		1	2	3
8			1	1
Total hospital	600	58	19	677
Total number of death	100	69	56	225
3. Data from Chandoev wit (2007) include all maternal death in the hospitals	Death in hospital			
0	532	22	2	556
1	58	23	4	85
2	9	8	6	23
3	1	2	4	7
4		2		2
5			2	2
7		1		1
8			1	1
Total	600	58	19	677
Total number of death	79	45	28	152

Appendix E

Balancing Test

The balancing test helps us pick a propensity score specification for a given X . In this study we use regression-based balancing test and assume a quartic functional form as follow.

$$X_k = \beta_0 + \beta_1\hat{P}(X) + \beta_2\hat{P}(X)^2 + \beta_3\hat{P}(X)^3 + \beta_4\hat{P}(X)^4 + \beta_5D + \beta_6D\hat{P}(X) + \beta_7D\hat{P}(X)^2 + \beta_8D\hat{P}(X)^3 + \beta_9D\hat{P}(X)^4 + \xi$$

We test whether: $\beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$. If not, variable X_k is dropped. The new propensity score is re-estimated. The balancing test is performed again. Variables that do not passed the test are dropped. The estimated propensity scores used for matching are the estimates that all X_k passed the balancing tests.

Appendix F

Table F1 Mean Impact on labour cost (1.5 nurse-equivalent) based on program participation in Tables 6 and 7

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	-0.1746	-1.0913	-0.3132	-1.7675	-0.3623	-2.2186*	0.1340	0.9229
Five nearest neighbor	-0.1694	-1.4368	-0.1130	-0.8692	-0.0706	-0.5869	0.1687	1.5591
Caliper (0.05)	-0.1589	-1.3698	-0.1472	-1.2443	-0.0756	-0.6842	0.1582	1.6012
Kernel, normal, bandwidth (0.01)	-0.1618	-1.0260	-0.1567	-0.9655	-0.0600	-0.3266	0.1514	1.1810
Kernel, normal, bandwidth (0.1)	-0.0535	-0.3321	-0.0387	-0.2242	-0.0447	-0.2719	0.1491	1.2083
LLR bandwidth (0.01)	-0.1594	-0.4366	-0.1560	-0.1040	-0.4893	-0.8461	0.1510	1.4575
LLR bandwidth (0.1)	-0.1424	-1.1867	-0.1273	-1.0752	-0.0932	-0.8678	0.1715	1.9098*
Program participation before 2005								
Single nearest neighbor	-0.3421	-1.5882	-0.2842	-1.3870	-0.1824	-0.9311	-0.0175	-0.1056
Five nearest neighbor	-0.2667	-1.5679	-0.2226	-1.1815	-0.2406	-1.6148	-0.0569	-0.3669
Caliper (0.05)	-0.2545	-1.4147	-0.2471	-1.3743	-0.2606	-1.3943	-0.0442	-0.2752
Kernel, normal, bandwidth (0.01)	-0.3448	-1.4549	-0.2512	-1.2473	-0.2451	-1.1279	-0.0564	-0.3285
Kernel, normal, bandwidth (0.1)	-0.2019	-0.8595	-0.1679	-0.7566	-0.2073	-0.9470	-0.0208	-0.1121
LLR bandwidth (0.01)	-0.3625	-0.2633	-0.2701	-0.5180	-0.2344	-0.4288	-0.1860	-0.3917
LLR bandwidth (0.1)	-0.3219	-2.0503*	-0.2884	-1.8999	-0.2863	-1.6212	-0.0275	-0.1935

Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Table F2 Program participation before 2003: sub-sample

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
1. Director and his/her response to policy								
pass HA evaluation (1=yes)	0.0876	1.11	0.0933	1.25	0.1198	1.47	0.0634	0.87
hospital has SMH policy (1=yes)	0.1663	0.49	0.1595	0.51	-0.1010	-0.32	-0.0752	-0.28
director announces SMH policy (1=yes)	0.3236	1.25	0.3937	1.63	0.2226	0.94	0.3316	1.55
staff have attended training in the past 6 months (1=yes)	0.2075	1.14	0.1034	0.62	0.0101	0.06	-0.0553	-0.36
no. of change of director since 1998	-0.0165	-1.08	-0.0096	-0.69	-0.0198	-1.31	-0.0189	-1.52
no. of year director's been practicing	0.0036	0.90	0.0040	1.07	0.0039	0.92		
2. Geographic and health facilities in the district								
northeast (1=yes)	0.1114	0.90	-0.0151	-0.16	0.2088	1.63	0.0773	0.92
north (1=yes)	-0.0856	-0.84	-0.2077	-2.38**	-0.0549	-0.52		
south (1=yes)	0.7075	4.02**			0.7487	0.18		
no. of villages in the district	-0.0026	-1.59			-0.0022	-1.29		
distance to referral hospital (km.)	-0.0001	-0.26			-0.0002	-0.26		
distance to the nearest private hospital (km.)	0.0010	1.20	0.0009	1.28	0.0013	1.42	0.0009	1.34
no. of private hospitals in the district	0.1349	1.85*	0.1278	1.83*	0.0833	0.90		
no. of private hospitals in the province	-0.0108	-1.04	-0.0053	-0.56	-0.0169	-1.57	-0.0042	-0.47
no. of primary care units in the catchment area	0.0063	1.24	0.0041	0.87	0.0118	1.70*	0.0094	1.80*
population in catchment area / 10,000	0.0035	0.60	0.0045	0.73	-0.0424	-1.95*		
population in catchment area per doctor /10,000	0.0094	0.18	0.001	0.02	0.1538	2.45**	0.0072	0.16
population in catchment area per nurse /10,000	-1.2867	-1.62	-1.2013	-1.62	-0.8774	-1.12	-1.0570	-1.69*
3. Socio-demographic structure								
no. of households in the district /1,000	-0.0073	-0.18	0.0035	0.09	-0.0503	-1.06	0.0064	0.80
household size	0.2444	1.45	0.1978	1.28	0.0486	0.28	0.2614	2.53**
population in TAO / 10,000	0.1136	1.02	0.0338	0.34	0.1932	1.51		
proportion of females	12.2967	2.74**	6.1838	1.52	12.4630	2.82**	8.6840	2.32*
proportion of females aged 15-49	-0.1913	-0.05			0.3125	0.09		
proportion of population aged 60+	-1.0460	-0.39	-0.8399	-0.49	-1.4262	-0.52	-0.5424	-0.33
proportion of Islamic population	-1.2522	-2.40**			-1.2001	-1.81*		

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
proportion of villages with lower secondary school	-0.3487	-1.44	-0.2645	-1.20	-0.2707	-1.14	-0.1905	-0.88
proportion of villages with upper secondary school	0.0778	0.21			-0.0548	-0.15	-0.0380	-0.12
non-students with lower secondary education / population	0.0487	0.19	0.1617	0.69	0.1451	0.57	0.2566	1.16
non-students with upper secondary education / population	0.2841	0.15	-0.1771	-0.10	0.1385	0.07	-0.4614	-0.28
non-students with diploma degree / population	4.2942	0.84	6.0035	1.63	2.8708	0.53	7.1951	1.78*
non-students with degree higher than diploma / population	-3.4551	-0.58			-3.4321	-0.58	-2.7033	-0.58
proportion of households with a member working in agricultural sector	0.4299	1.93*	0.5823	2.87**	0.3034	1.36	0.3547	1.95*
proportion of households with a member working as private employee	-0.1302	-0.46	-0.3438	-1.51	-0.1982	-0.69	-0.3488	-1.62
proportion of households owning a business	-0.1023	-0.25			-0.1567	-0.39		
4. Hospital resources, capacity and infrastructure								
new hospital or hospital opened after 1995 (1=yes)								
no. of doctors excluding gyn-ob	0.0217	0.23	0.0344	0.56	0.2214	0.80		
no. of gynaecologists and obstetricians	0.0137	0.11	0.0129	0.11	0.2403	0.80		
no. of anaesthetists								
no. of other health care workers and technical staff	0.0059	0.87	0.0094	1.45	0.0148	1.46		
no. of other staff	-0.0001	-0.51	-0.0002	-0.85	-0.0013	-1.38		
total no. of doctors in the hospital	-0.0293	-0.31	-0.0394	-0.68	-0.1549	-0.59		
total no. of nurses in the hospital	-0.0011	-0.76	-0.0013	-0.95	-0.0012	-0.36		
no. of beds	0.0022	1.41	0.0017	1.17	-0.0021	-0.88		
no. of ICUs	0.0055	0.94	0.0049	0.87	-0.1095	-2.81**		
no. of defibrillators	-0.0090	-0.45	-0.0023	-0.12	0.0225	0.68		
no. of respirators	0.0109	1.65*	0.0104	1.69*	0.0854	2.98**		
no. of ultrasound machines	-0.0366	-0.86	-0.0566	-1.38	-0.0595	-1.09	-0.0440	-1.01
no. of EKGs	-0.0135	-2.07*	-0.0131	-2.18*	-0.0048	-0.21		
budget allocated from government in 2006 (Bth100 mil.)	0.1126	0.88	0.0841	0.67	0.1262	0.45		
income generated in 2006 (Bth100 mil.)	-0.0327	-0.68	-0.0353	-0.78	0.0770	0.60		
no. of outpatients /10,000	0.0116	1.26	0.0124	1.45	0.0085	0.74		
no. of inpatients admitted /10,000	-0.2298	-1.69*	-0.1740	-1.39	-0.3135	-1.56		

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
new antenatal patients /1,000	-0.0022	-0.02	-0.0059	-0.07	0.0058	0.05	0.0760	0.96
total child deliveries /1,000	-0.0910	-0.96	-0.0578	-0.68	-0.0805	-0.48		
community hospital (1=yes)	-0.3892	-1.75*	-0.3823	-1.90				
constant	-7.7871	-3.12**	-4.7215	-2.19*	-7.1777	-2.83**	-6.0735	-3.18**
N	466		480		402		415	
LR chi ²	160.26		140.33		124.72		62.95	
Prob > chi ²	0.000		0.000		0.000		0.000	
Log likelihood	-235.266		-252.47		-197.479		-233.816	
Pseudo R ²	0.2541		0.2175		0.2400		0.1187	

Note: Drop hospital participating SMH program in 2003 and 2004.

Note: t-statistics. * p<0.05, ** p<0.01

Table F3 Mean impact: sub-sample

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Maternal death taking place in hospital								
Single nearest neighbor	0.0622	0.4511	-0.0634	-0.4481	-0.0108	-0.0779	-0.0148	-0.1448
Five nearest neighbor	0.0306	0.2797	-0.0789	-0.7160	0.0066	0.0638	0.0183	0.2047
Caliper (0.05)	0.0188	0.1954	-0.0733	-0.8020	0.0412	0.4100	0.0007	0.0086
Kernel, normal, bandwidth (0.01)	0.0157	0.1201	-0.0674	-0.5122	0.0369	0.2604	0.0236	0.1936
Kernel, normal, bandwidth (0.1)	0.0090	0.0843	-0.0400	-0.3213	0.0366	0.3015	0.0037	0.0330
LLR bandwidth (0.01)	0.0178	0.0804	-0.0667	-0.4195	0.0366	0.1140	0.1587	0.3466
LLR bandwidth (0.1)	0.0203	0.2034	-0.0612	-0.7816	0.0362	0.4031	0.0038	0.0433
Maternal death in the district								
Single nearest neighbor	0.0859	0.5796	-0.0404	-0.2833	0.0395	0.2999	0.0048	0.0384
Five nearest neighbor	0.0752	0.6378	-0.0442	-0.3870	0.0420	0.3794	0.0454	0.4789
Caliper (0.05)	0.0517	0.5099	-0.0496	-0.4844	0.0629	0.5465	0.0188	0.2401
Kernel, normal, bandwidth (0.01)	0.0555	0.3632	-0.0442	-0.3196	0.0622	0.4618	0.0445	0.3687
Kernel, normal, bandwidth (0.1)	0.0365	0.2980	-0.0176	-0.1360	0.0538	0.3718	0.0179	0.1424
LLR bandwidth (0.01)	0.0573	0.0369	-0.0457	-0.2127	0.0670	0.1150	0.1859	1.5077
LLR bandwidth (0.1)	0.0498	0.5020	-0.0395	-0.3699	0.0511	0.5634	0.0129	0.1488
Length of stay for birth giving								
Single nearest neighbor	-0.0384	-0.2911	0.0441	0.3969	0.0010	0.0078	-0.0238	-0.2543
Five nearest neighbor	-0.0778	-0.7553	-0.0471	-0.5114	-0.1171	-1.2770	-0.0843	-0.9837
Caliper (0.05)	-0.0551	-0.6184	-0.0715	-0.8656	-0.0684	-0.7516	-0.1204	-1.6359
Kernel, normal, bandwidth (0.01)	-0.0727	-0.5765	-0.0390	-0.3488	-0.0669	-0.6005	-0.0955	-0.8682
Kernel, normal, bandwidth (0.1)	-0.0403	-0.3398	-0.0692	-0.5608	-0.0646	-0.5131	-0.0828	-0.8415
LLR bandwidth (0.01)	-0.0936	-0.0891	-0.0251	-0.1083	-0.0872	-0.3530	0.0019	0.0067
LLR bandwidth (0.1)	-0.0434	-0.5041	-0.0855	-0.9828	-0.0835	-0.8591	-0.0947	-1.1451
labour cost (1.5 nurse-equivalent)								
Single nearest neighbor	-0.0767	-0.3553	-0.0386	-0.1999	-0.1698	-0.8299	-0.0725	-0.3768
Five nearest neighbor	-0.1042	-0.5207	-0.0336	-0.1746	-0.0735	-0.4409	0.0306	0.1853
Caliper (0.05)	-0.0591	-0.3762	-0.0183	-0.1102	-0.1370	-0.8595	-0.0888	-0.6943

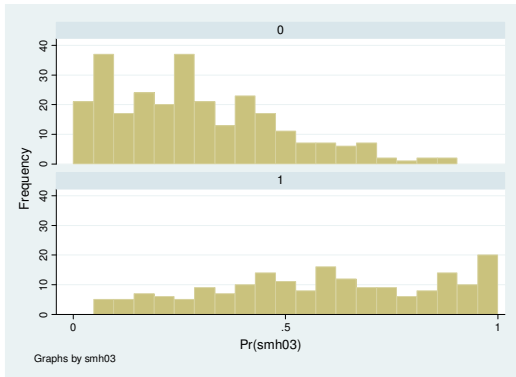
Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Kernel, normal, bandwidth (0.01)	-0.0799	-0.3326	-0.0213	-0.1007	-0.1993	-1.0987	-0.0681	-0.3220
Kernel, normal, bandwidth (0.1)	0.0163	0.0693	0.0460	0.1990	-0.0350	-0.1532	0.0423	0.2042
LLR bandwidth (0.01)	-0.1614	-0.3727	-0.0074	-0.0027	-0.2324	-0.1940	0.2405	0.9840
LLR bandwidth (0.1)	-0.0671	-0.4335	-0.0463	-0.2867	-0.0879	-0.5282	-0.0018	-0.0127
labour cost (2 nurse-equivalent)								
Single nearest neighbor	-0.1105	-0.4479	-0.0859	-0.3696	-0.2258	-0.8492	-0.1316	-0.5917
Five nearest neighbor	-0.1433	-0.6452	-0.0695	-0.3546	-0.1290	-0.5811	-0.0046	-0.0228
Caliper (0.05)	-0.0880	-0.4825	-0.0541	-0.3226	-0.1870	-0.8566	-0.1342	-0.7821
Kernel, normal, bandwidth (0.01)	-0.1086	-0.3951	-0.0602	-0.2443	-0.2601	-1.0952	-0.1174	-0.5403
Kernel, normal, bandwidth (0.1)	-0.0046	-0.0172	0.0256	0.1016	-0.0758	-0.2874	0.0191	0.0846
LLR bandwidth (0.01)	-0.2081	-0.2409	-0.0438	-0.0804	-0.2889	-0.1729	0.1898	0.1396
LLR bandwidth (0.1)	-0.0984	-0.4699	-0.0904	-0.4908	-0.1448	-0.7934	-0.0356	-0.2297
Referred in per child delivery								
Single nearest neighbor	0.0061	0.4420	-0.0079	-0.7670	0.0064	0.5079	-0.0071	-0.7978
Five nearest neighbor	-0.0047	-0.5109	-0.0062	-0.7750	-0.0058	-0.5979	-0.0084	-1.1831
Caliper (0.05)	0.0003	0.0380	-0.0041	-0.5256	-0.0022	-0.2444	-0.0074	-1.1563
Kernel, normal, bandwidth (0.01)	0.0026	0.2430	-0.0069	-0.6509	0.0000	0.0000	-0.0063	-0.7875
Kernel, normal, bandwidth (0.1)	0.0052	0.5049	0.0014	0.1489	-0.0032	-0.2857	-0.0052	-0.5591
LLR bandwidth (0.01)	0.0028	0.0320	-0.0078	-0.3900	0.0006	0.0227	-0.0416	-3.8519**
LLR bandwidth (0.1)	0.0016	0.2025	-0.0079	-1.2540	-0.0087	-0.9886	-0.0085	-1.4655
Referred out per child delivery								
Single nearest neighbor	0.0154	0.7333	0.0169	0.9389	-0.0165	-0.7205	-0.0023	-0.1322
Five nearest neighbor	0.0135	0.8333	0.0113	0.8248	-0.0088	-0.5238	-0.0028	-0.1986
Caliper (0.05)	0.0008	0.0559	0.0119	0.9154	-0.0079	-0.5130	-0.0062	-0.6458
Kernel, normal, bandwidth (0.01)	0.0087	0.4203	0.0117	0.6324	-0.0098	-0.5026	-0.0069	-0.4423
Kernel, normal, bandwidth (0.1)	-0.0018	-0.0793	0.0022	0.1250	-0.0077	-0.3738	-0.0103	-0.7305
LLR bandwidth (0.01)	0.0171	0.0711	0.0112	0.4590	-0.0123	-0.1841	-0.0110	-0.1505
LLR bandwidth (0.1)	0.0005	0.0345	0.0159	1.3826	-0.0016	-0.1119	-0.0059	-0.5221

Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

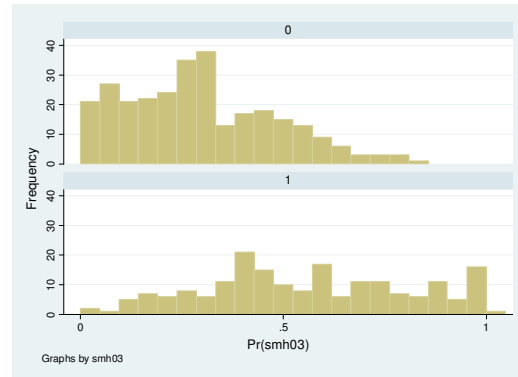
Figure F1 Distribution of $P(X_i)$ from probit estimates in table F2

(a) Total sample

Before the balancing test

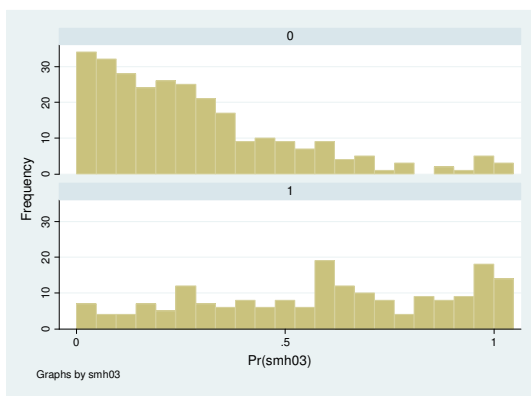


After dropping variables that do not pass the balancing test



(b) Community hospital

Before the balancing test



After dropping variables that do not pass the balancing test

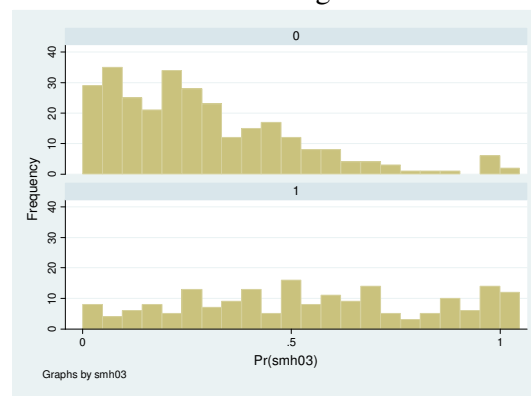


Table 1 SMH Process Evaluation: Number of Hospitals Evaluated and Evaluation Outcomes

Health Region	Type of Hospital	No. of hospital	Evaluation		
			No. evaluated	Pass	Fail
1	Centre	1	1	1	
	General	4	3	3	
	Community	33	8	7	1
	Sub-total	38	12	11	1
2	Centre	1	0	0	
	General	6	5	5	
	Community	27	12	12	
	Health Promotion	1	1	1	
	Sub-total	35	18	18	0
3	Centre	4	4	4	
	General	5	5	5	
	Community	61	17	17	
	Health Promotion	1	1	1	
	Sub-total	71	26	26	0
4	Centre	3	3	3	
	General	10	10	10	
	Community	61	52	52	
	Health Promotion	1	0	0	
	Sub-total	71	65	65	0
5	Centre	3	1	1	
	General	1	1	1	
	Community	71	27	25	2
	Sub-total	75	29	27	2
6	Centre	2	2	2	
	General	6	6	6	
	Community	92	92	77	15
	Sub-total	100	100	85	15
7	Centre	1	1	1	
	General	7	7	7	
	Community	95	95	76	19
	Sub-total	103	103	84	19
8	Centre	1	1	1	
	General	3	3	3	
	Community	36	32	25	7
	Sub-total	40	36	29	7
9	Centre	2	2	2	
	General	5	5	5	
	Community	39	39	30	9

Health Region	Type of Hospital	No. of hospital	Evaluation		
			No. evaluated	Pass	Fail
	Sub-total	46	46	37	9
10	Centre	2	2	2	
	General	7	6	6	
	Community	85	29	15	14
	Sub-total	94	37	23	14
11	Centre	2	2	2	
	General	7	7	6	1
	Community	65	48	40	8
	Sub-total	74	57	48	9
12	Centre	3	2	2	
	General	7	7	6	1
	Community	64	60	60	
	Sub-total	74	69	68	1
Total		821	598	521	77

Source: Department of Health.

Note: This come from process evaluations performed by supervision teams from the DOH, Provincial Public Health Office and regional hospitals. Data are collected up to February of 2005. Health promotion hospitals are hospitals under supervision of the DOH, unlike community, general and regional hospitals. The hospitals were called "Mother and Child Health Hospital." They have changed the name and the role of the hospitals. There are 12 health promotion hospitals in 12 health regions. Only some of them are now providing acute care. The hospitals focus more on research and training for local health personnel.

Table 2 Hospital Survey Response

	Questionnaire sent out	Received	% Received
Community hospital	730	627	86
General hospital	70	59	84
Regional hospital	25	22	88
Health promotion centre	12	10	83
Total	837	718	86

Table 3 Descriptive Statistics

Variable label	Mean	Std. Dev.	Min	Max	N
1. Director and his/her response to policy					
pass HA evaluation ^a (1=yes)	0.91	0.35	0	2.5	677
hospital has SMH policy (1=yes)	0.99	0.11	0	1	677
director announces SMH policy (1=yes)	0.98	0.14	0	1	677
staff have attended training in the past 6 months (1=yes)	0.97	0.16	0	1	677
no. of change of director since 1998	1.89	2.38	0	13	677
no. of year director's been practicing	15.38	9.22	0	35	677
2. Geographic and health facilities in the district					
northeast (1=yes)	0.35	0.48	0	1	677
north (1=yes)	0.24	0.43	0	1	677
south (1=yes)	0.17	0.38	0	1	677
no. of villages in the district	83.30	49.30	6	320	675
distance to referral hospital (km.)	63.81	60.37	0	466	677
distance to the nearest private hospital (km.)	48.68	43.75	0	300	677
no. of private hospitals in the district	0.21	0.70	0	5	677
no. of private hospitals in the province	3.32	3.20	0	23	677
no. of primary care units in the catchment area	12.18	6.93	0	79	677
population in catchment area / 10,000	6.88	9.05	0.15	143.59	677
population in catchment area per doctor /10,000	1.17	0.75	0.04	8.70	677
population in catchment area per nurse /10,000	0.11	0.09	0.01	1.32	677
3. Socio-demographic structure^b					
no. of households in the district /1,000	9.56	5.75	0.46	36.11	675
household size	3.93	0.37	2.83	5.35	675
population in TAO ^a /10,000	3.56	2.21	0.16	14.19	675
proportion of females	0.51	0.01	0.48	0.55	675
proportion of females aged 15-49	0.29	0.01	0.23	0.34	675
proportion of population aged 0-14	0.21	0.03	0.13	0.37	675
proportion of population aged 15-49	0.68	0.03	0.58	0.76	675
proportion of population aged 60+	0.12	0.03	0.05	0.20	675
proportion of Islamic population	0.06	0.19	0	0.98	675
proportion of villages with lower secondary school	0.66	0.14	0.07	1	674
proportion of villages with upper secondary school	0.19	0.09	0.03	0.75	672
non-students with lower secondary education / population	0.47	0.13	0.01	0.81	675
non-students with upper secondary education / population	0.05	0.03	0	0.60	675
non-students with diploma degree ^a / population	0.02	0.01	0	0.10	675
non-students with degree higher than diploma / population	0.02	0.01	0	0.09	675
proportion of households with a member working in agricultural sector	0.66	0.20	0.002	0.996	675
proportion of households with a member working as private employee	0.35	0.13	0.06	0.87	675
proportion of households owning a business	0.07	0.10	0.	0.59	675
4. Hospital resources, capacity and infrastructure					
new hospital or hospital opened after 1995 (1=yes)	0.03	0.16	0	1	677
no. of doctors excluding gyn-ob	9.25	18.77	1	200	677
no. of gynaecologists and obstetricians	0.78	2.04	0	18	677
no. of anaesthetists	0.23	0.90	0	10	677
no. of other health care workers and technical staff	13.13	15.03	2	123	677
no. of other staff	116.64	185.98	0	1,942	677
total no. of doctors in the hospital	10.25	21.53	1	228	677
total no. of nurses in the hospital	84.30	123.62	3	1,025	677
no. of beds	87.86	139.65	10	1,029	677
no. of ICUs	2.30	8.69	0	150	677

Variable label	Mean	Std. Dev.	Min	Max	N
no. of defibrillators	2.36	3.78	0	66	677
no. of respirators	4.31	14.18	0	196	677
no. of ultrasound machines	1.37	1.16	0	13	677
no. of EKGs	3.50	7.01	0	73	677
budget allocated from government in 2006 (Bth100 mil.)	0.31	0.46	0.005	5.62	677
income generated in 2006 (Bth100 mil.)	0.71	1.48	0.000001	15.10	676
no. of outpatients /10,000	9.99	9.14	0.107	68.98	677
no. of inpatients admitted /10,000	0.73	1.05	0.014	8.63	677
new antenatal patients /1,000	0.53	0.57	0.009	4.51	677
total child deliveries /1,000	0.74	1.05	0.010	8.50	677
community hospital (1=yes)	0.89	0.32	0	1	677

Note: Total sample of 678 hospitals. The data is for Fiscal Year 2006 (*i.e.* October 1, 2005-September 30, 2006).

^a More details about some variables are as follows:

HA refers to Hospital Accreditation. It is an evaluation system that promotes quality improvement. The evaluation is done by the Institute of Hospital Quality Improvement & Accreditation.

TAO stands for Tambon Administration Organization.

Diploma is a two-year education after graduating high school. This includes vocational training and many types of certificates.

^b Data are from National Rural Development Database (NRD2C) collected by the Community Development Department, Ministry of Interior. Two missing districts are Samui island and Si Chung island.

Table 4 Year Pass Process Evaluation

Year	No. of hospitals	Percent passed each year	Percent have passed
not yet passed	57	8.42	
1998	2	0.30	0.30
1999	23	3.40	3.69
2000	16	2.36	6.06
2001	82	12.11	18.17
2002	69	10.19	28.36
2003	106	15.66	44.02
2004	88	13.00	57.02
2005	112	16.54	73.56
2006	98	14.48	88.04
2007	24	3.55	91.58
Total	678	100	

Table 5 No. of Maternal Deaths in the District where Hospitals Located

No. of maternal deaths	From the survey			From Chandoev wit <i>et al.</i> (2007)		
	Community hospital	General hospital	Regional hospital	Community hospital	General hospital	Regional hospital
0	581	33	7	515	20	1
1	17	10	3	74	20	3
2	1	10	4	7	13	6
3	1	4	1	4	2	5
4			3		1	1
5			1			
6					1	
7		1			1	2
8						1
Sub-total	22	42	31	100	69	56
Total	95			225		

Note: Include only districts in the working samples, 677 hospitals.

Table 6 Program participation before 2004

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
1. Director and his/her response to policy								
pass HA evaluation (1=yes)	0.0275	0.43	0.0264	0.42	0.0567	0.83	0.0063	0.11
hospital has SMH policy (1=yes)	0.0397	0.14	0.0419	0.15	-0.1002	-0.35	-0.0305	-0.12
director announces SMH policy (1=yes)	0.2472	1.09	0.2404	1.06	0.2165	0.95	0.3046	1.38
staff have attended training in the past 6 months (1=yes)	0.0766	0.50	0.0804	0.53	-0.0886	-0.56	0.1303	0.89
no. of change of director since 1998	-0.0094	-0.85	-0.0097	-0.88	-0.0109	-0.96	-0.0167	-1.87*
no. of year director's been practicing	0.0041	1.26	0.0039	1.23	0.0050	1.44		
2. Geographic and health facilities in the district								
northeast (1=yes)	0.0603	0.62	0.0624	0.64	0.1088	1.04	0.1131	1.85*
north (1=yes)	-0.0277	-0.34	-0.0241	-0.30	-0.0159	-0.18		
south (1=yes)	0.2671	2.59**	0.2687	2.60**	0.3465	3.17**	0.2982	3.71**
no. of villages in the district	-0.0029	-2.14*	-0.0028	-2.12*	-0.0033	-2.17*		
distance to referral hospital (km.)	0.0002	0.50			0.0002	0.27		
distance to the nearest private hospital (km.)	-0.0003	-0.42	-0.0001	-0.25	0.0003	0.45		
no. of private hospitals in the district	0.0985	1.53	0.1013	1.58	0.0668	0.76		
no. of private hospitals in the province	-0.0173	-2.01*	-0.0172	-2.01*	-0.0230	-2.46**		
no. of primary care units in the catchment area	0.0038	0.82	0.0037	0.81	0.0091	1.67*		
population in catchment area / 10,000	-0.0002	-0.03	-0.0004	-0.09	-0.0393	-2.07*		
population in catchment area per doctor /10,000	0.0147	0.34	0.0155	0.36	0.1419	2.43**		
population in catchment area per nurse /10,000	-0.6846	-1.34	-0.6762	-1.32	-0.7041	-1.12	-0.7226	-2.21*
3. Socio-demographic structure								
no. of households in the district /1,000	0.0038	0.12	0.0050	0.16	-0.0143	-0.41		
household size	0.1151	1.00	0.1148	1.00	0.0433	0.36	0.1111	1.50
population in TAO / 10,000	0.0680	0.80	0.0640	0.75	0.1258	1.33		
proportion of females	11.9708	3.34**	11.9014	3.33**	12.8607	3.48**	11.8932	3.92**
proportion of females aged 15-49	-2.2915	-0.90	-2.2962	-0.90	-2.7655	-1.04		
proportion of population aged 60+	-2.5932	-1.40	-2.6210	-1.41	-3.0715	-1.57	-2.6690	-2.20*
proportion of Islamic population	-0.2682	-1.57	-0.2714	-1.59	-0.2709	-1.57	-0.3234	-2.11*

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
proportion of villages with lower secondary school	-0.0310	-0.17	-0.0288	-0.15	-0.0316	-0.16	0.0257	0.15
proportion of villages with upper secondary school	-0.1128	-0.39	-0.1112	-0.39	-0.1650	-0.57	0.0269	0.10
non-students with lower secondary education / population	-0.1517	-0.81	-0.1446	-0.77	-0.1985	-1.03	-0.1862	-1.11
non-students with upper secondary education / population	-1.5314	-1.25	-1.5330	-1.25	-0.7487	-0.76	-0.8452	-1.06
non-students with diploma degreea / population	2.8065	0.77	2.7569	0.76	-0.2658	-0.07		
non-students with degree higher than diploma / population	0.6793	0.18	0.6647	0.17	2.2965	0.58	3.1553	1.12
proportion of households with a member working in agricultural sector	0.3370	1.98*	0.3378	1.99*	0.3113	1.76*		
proportion of households with a member working as private employee	-0.3063	-1.31	-0.3103	-1.33	-0.4107	-1.68*	-0.3220	-1.81*
proportion of households owning a business	0.0449	0.13	0.0511	0.15	0.0531	0.15		
4. Hospital resources, capacity and infrastructure								
new hospital or hospital opened after 1995 (1=yes)	-0.5135	-2.47**	-0.5131	-2.48**	-0.5216	-2.52**		
no. of doctors excluding gyn-ob	-0.0132	-0.25	-0.0122	-0.23	0.0568	0.23		
no. of gynaecologists and obstetricians					0.0793	0.30		
no. of anaesthetists	-0.0565	-0.52	-0.0608	-0.56				
no. of other health care workers and technical staff	-0.0019	-0.52	-0.0019	-0.55	-0.0026	-0.63		
no. of other staff	-0.0006	-2.03*	-0.0005	-2.08*	-0.0018	-2.41**		
total no. of doctors in the hospital	0.0101	0.20	0.0094	0.19	-0.0017	-0.01		
total no. of nurses in the hospital	-0.0015	-1.15	-0.0015	-1.16	-0.0029	-0.98		
no. of beds	0.0022	1.70*	0.0022	1.74*	-0.0019	-0.98		
no. of ICUs	0.0032	0.61	0.0034	0.67	-0.0946	-2.65**		
no. of defibrillators	-0.0160	-1.01	-0.0157	-0.99	0.0184	0.63		
no. of respirators	0.0041	0.79	0.0039	0.75	0.0935	3.55**		
no. of ultrasound machines	0.0227	0.66	0.0231	0.67	0.0058	0.13		
no. of EKGs	-0.0061	-1.09	-0.0062	-1.10	0.0120	0.56		
budget allocated from government in 2006 (Bth100 mil.)	0.1415	1.32	0.1433	1.34	0.2603	1.09		
income generated in 2006 (Bth100 mil.)	-0.0268	-0.62	-0.0263	-0.61	0.0062	0.06		
no. of outpatients /10,000	0.0074	1.05	0.0067	0.98	0.0121	1.27		
no. of inpatients admitted /10,000	-0.0312	-0.63	-0.0308	-0.62	-0.0206	-0.40		

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
new antenatal patients /1,000	0.0465	0.68	0.0453	0.66	0.0748	0.86		
total child deliveries /1,000	-0.0324	-0.42	-0.0227	-0.30	-0.0830	-0.65		
community hospital (1=yes)	-0.1720	-1.03	-0.1808	-1.09				
constant	-5.9951	-3.07**	-5.9401	-3.05**	-5.9116	-2.9**	6.4566	-4.31**
N	671		671		595		672	
LR chi2	146.26		146.01		127.61		60.80	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	-387.073		-387.20		-335.81		-430.93	
Pseudo R2	0.1589		0.1586		0.160		0.065	

Note: t-statistics. * p<0.05, ** p<0.01

Table 7 Program participation before 2005

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
1. Director and his/her response to policy								
pass HA evaluation (1=yes)	0.0645	1.00	0.0602	0.95	0.0935	1.28	0.0359	0.61
hospital has SMH policy (1=yes)	0.1103	0.40	0.1143	0.41	0.0057	0.02	-0.0174	-0.07
director announces SMH policy (1=yes)	0.2630	1.17	0.2777	1.22	0.2163	0.90	0.3359	1.57
staff have attended training in the past 6 months (1=yes)	0.2258	1.41	0.2117	1.32	0.0637	0.36	0.2416	1.60
no. of change of director since 1998	-0.0040	-0.35	-0.0048	-0.44	-0.0068	-0.55	-0.0137	-1.52
no. of year director's been practicing	0.0054	1.65*	0.0056	1.76*	0.0059	1.57		
2. Geographic and health facilities in the district								
northeast (1=yes)	0.0436	0.44	0.1625	2.10*	0.0902	0.82	0.0763	1.25
north (1=yes)	0.0367	0.45	0.1110	1.52	0.0687	0.74		
south (1=yes)	0.6768	5.34**	0.7724	6.66**	0.8119	5.71**	0.6098	5.83***
no. of villages in the district	-0.0028	-2.03*	-0.0030	-2.24*	-0.0032	-1.97*		
distance to referral hospital (km.)	-0.0004	-0.74	0.0010	1.69*	-0.0005	-0.70		
distance to the nearest private hospital (km.)	0.0010	1.47	0.0899	1.50	0.0014	1.77*		
no. of private hospitals in the district	0.1282	2.02*	-0.0265	-3.30**	0.1113	1.24		
no. of private hospitals in the province	-0.0224	-2.66**	0.0048	1.03	-0.0308	-3.19**		
no. of primary care units in the catchment area	0.0058	1.25	0.0026	0.54	0.0113	1.85*		
population in catchment area / 10,000	0.0036	0.62			-0.0355	-1.74*		
population in catchment area per doctor /10,000	-0.0182	-0.43	-0.8375	-1.98*	0.0955	1.56	-0.7447	-2.34**
population in catchment area per nurse /10,000	-0.7345	-1.54	0.1625	2.10*	-0.7461	-1.20	0.0763	1.25
3. Socio-demographic structure								
no. of households in the district /1,000	0.0184	0.59	0.0006	0.02	0.0037	0.10		
household size	0.2276	1.95*	0.1761	1.54	0.1497	1.17	0.1350	1.73*
population in TAO / 10,000	0.0195	0.22	0.0753	0.89	0.0546	0.53		
proportion of females	12.9874	3.59**	11.2983	3.20**	14.2986	3.66**	8.4368	2.79**
proportion of females aged 15-49	0.9035	0.34			2.1622	0.75		
proportion of population aged 60+	-2.4169	-1.24	-2.5475	-1.74*	-1.8578	-0.86	-2.6478	-2.09*
proportion of Islamic population	-0.0714	-0.30	-0.1797	-0.80	0.0338	0.12	-0.1275	-0.58

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
proportion of villages with lower secondary school	-0.1791	-0.92	-0.2310	-1.20	-0.0592	-0.28	-0.0351	-0.20
proportion of villages with upper secondary school	0.2703	0.94	0.2824	1.01	0.2110	0.69	0.3325	1.28
non-students with lower secondary education / population	-0.1241	-0.65	-0.0500	-0.27	-0.0921	-0.44	-0.1492	-0.87
non-students with upper secondary education / population	0.8062	0.73	0.2456	0.33	1.0289	0.87	0.5307	0.63
non-students with diploma degreea / population	-2.3638	-0.63			-5.3575	-1.23		
non-students with degree higher than diploma / population	2.0179	0.48			3.8845	0.85	0.5787	0.20
proportion of households with a member working in agricultural sector	0.4229	2.45**			0.3619	1.90*		
proportion of households with a member working as private employee	-0.2401	-1.03			-0.2854	-1.11	-0.3866	-2.15*
proportion of households owning a business	-0.1921	-0.56			-0.2045	-0.55		
4. Hospital resources, capacity and infrastructure								
new hospital or hospital opened after 1995 (1=yes)	-0.5827	-3.05**	-0.5835	-2.98**	-0.6669	-3.07**		
no. of doctors excluding gyn-ob	-0.0033	-0.06	-0.0102	-0.19	0.1287	0.45		
no. of gynaecologists and obstetricians					0.1599	0.53		
no. of anaesthetists	-0.0475	-0.45	-0.0447	-0.43				
no. of other health care workers and technical staff	0.0086	1.58	0.0074	1.48	0.0114	1.23		
no. of other staff	0.0003	1.00	0.0002	0.92	-0.0008	-0.95		
total no. of doctors in the hospital	-0.0063	-0.12	0.0004	0.01	-0.0993	-0.36		
total no. of nurses in the hospital	-0.0019	-1.45	-0.0020	-1.64	-0.0040	-1.21		
no. of beds	0.0017	1.34	0.0023	1.82*	-0.0004	-0.21		
no. of ICUs	0.0014	0.25	0.0000	0.01	-0.0843	-2.25*		
no. of defibrillators	0.0016	0.10	0.0007	0.05	0.0140	0.45		
no. of respirators	0.0072	1.25	0.0067	1.18	0.0567	2.04*		
no. of ultrasound machines	-0.0272	-0.79	-0.0283	-0.83	-0.0070	-0.15		
no. of EKGs	-0.0127	-2.14*	-0.0118	-2.00*	-0.0036	-0.16		
budget allocated from government in 2006 (Bth100 mil.)	0.1064	1.00	0.1088	1.05	0.3050	1.17		
income generated in 2006 (Bth100 mil.)	0.0071	0.18	0.0071	0.18	-0.0065	-0.05		
no. of outpatients /10,000	0.0033	0.46	0.0011	0.17	0.0066	0.66		
no. of inpatients admitted /10,000	-0.0785	-1.35	-0.0764	-1.36	-0.0588	-0.89		

Variables	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics	Marginal effect	t-statistics
new antenatal patients /1,000	0.0296	0.41	0.0429	0.61	0.0368	0.38		
total child deliveries /1,000	-0.0823	-1.02	-0.1189	-1.56	0.0478	0.34		
community hospital (1=yes)	-0.2564	-1.39	-0.2484	0.18				
constant	-8.0292	-4.02**	-6.5697	1.83*	-8.9145	-4.07**	-4.9037	-3.27**
N	671		671		595		672	
LR chi2	220.74		207.98		206.84		133.82	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	-348.541		-354.92		-307.299		-392.56	
Pseudo R2	0.2405		0.2266		0.2518		0.1456	

Note: t-statistics. * p<0.05, ** p<0.01

Table 8 Mean Impact on Maternal Death Taking Place in Hospital

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	-0.1665	-1.7007*	-0.0479	-0.4052	-0.1158	-0.9445	0.0635	0.5695
Five nearest neighbor	-0.0534	-0.5574	-0.0512	-0.4543	-0.0330	-0.3642	-0.0113	-0.1220
Caliper (0.05)	-0.0506	-0.6632	-0.0553	-0.7126	-0.0162	-0.2007	-0.0255	-0.3717
Kernel, normal, bandwidth (0.01)	-0.0400	-0.3317	-0.0550	-0.4717	-0.0103	-0.0977	-0.0207	-0.1789
Kernel, normal, bandwidth (0.1)	-0.0455	-0.3988	-0.0480	-0.4156	-0.0271	-0.2557	-0.0123	-0.1231
LLR bandwidth (0.01)	-0.0419	-0.3483	-0.0660	-0.4603	-0.1129	-0.3763	-0.0215	-0.2194
LLR bandwidth (0.1)	-0.0478	-0.6298	-0.0513	-0.6697	-0.0217	-0.2878	-0.0161	-0.2170
Program participation before 2005								
Single nearest neighbor	0.0403	0.3328	0.1178	1.0556	0.0675	0.6262	0.0841	0.8427
Five nearest neighbor	0.0847	0.8296	0.0842	0.6599	0.0629	0.6538	0.0358	0.4000
Caliper (0.05)	0.0838	1.1263	0.0716	0.9299	0.0818	1.1821	0.0274	0.3774
Kernel, normal, bandwidth (0.01)	0.0711	0.7110	0.0979	0.8741	0.0767	0.7229	0.0354	0.3942
Kernel, normal, bandwidth (0.1)	0.0580	0.5321	0.0395	0.3399	0.0574	0.5013	0.0217	0.2038
LLR bandwidth (0.01)	0.0635	0.1172	0.1028	0.1678	0.0838	0.8089	0.0416	0.2645
LLR bandwidth (0.1)	0.0635	0.7820	0.0471	0.5439	0.0620	0.8378	0.0257	0.4276

Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Table 9 Mean Impact on Maternal Death in the District

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	-0.1481	-0.9187	-0.0659	-0.5161	-0.0730	-0.5309	0.0679	0.6258
Five nearest neighbor	-0.0307	-0.3095	-0.0447	-0.4557	-0.0336	-0.3032	0.0194	0.2304
Caliper (0.05)	-0.0423	-0.4603	-0.0466	-0.5016	-0.0130	-0.1472	-0.0208	-0.2283
Kernel, normal, bandwidth (0.01)	-0.0300	-0.2657	-0.0479	-0.4224	-0.0039	-0.0340	-0.0089	-0.0683
Kernel, normal, bandwidth (0.1)	-0.0401	-0.2666	-0.0425	-0.3284	-0.0280	-0.2566	-0.0098	-0.0910
LLR bandwidth (0.01)	-0.0322	-0.2949	-0.0616	-0.2938	-0.0886	-0.0762	-0.0080	-0.0760
LLR bandwidth (0.1)	-0.0333	-0.3569	-0.0372	-0.4101	-0.0233	-0.2794	-0.0093	-0.1191
Program participation before 2005								
Single nearest neighbor	0.0981	0.7176	0.1433	1.0552	0.0787	0.6153	0.1138	1.0206
Five nearest neighbor	0.1216	1.3771	0.1251	1.1835	0.0592	0.4318	0.0532	0.5905
Caliper (0.05)	0.1224	1.2777	0.1145	1.2027	0.0949	1.1587	0.0511	0.6436
Kernel, normal, bandwidth (0.01)	0.1107	0.8828	0.1382	1.1038	0.0823	0.6841	0.0582	0.5449
Kernel, normal, bandwidth (0.1)	0.0873	0.7468	0.0758	0.6620	0.0675	0.6350	0.0484	0.4632
LLR bandwidth (0.01)	0.1059	0.8216	0.1438	1.1261	0.0934	0.2928	0.0641	0.4693
LLR bandwidth (0.1)	0.1004	1.2741	0.0913	1.1161	0.0667	0.8730	0.0476	0.6142

Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Table 10 Mean Impact on Length of Stay for Birth Giving

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	-0.2342	-2.2284*	-0.2348	-2.3984**	-0.1465	-1.4377	-0.0680	-0.8028
Five nearest neighbor	-0.1770	-2.3600**	-0.1311	-1.7048*	-0.1450	-1.7019	-0.0016	-0.0230
Caliper (0.05)	-0.1139	-1.7154*	-0.1047	-1.6699*	-0.1042	-1.5058	-0.0234	-0.4349
Kernel, normal, bandwidth (0.01)	-0.1088	-0.8860	-0.1320	-1.2371	-0.1156	-1.0743	-0.0134	-0.1436
Kernel, normal, bandwidth (0.1)	-0.0874	-0.9278	-0.0791	-0.8055	-0.1001	-0.8047	-0.0326	-0.3840
LLR bandwidth (0.01)	-0.0819	-0.2022	-0.1472	-0.5770	-0.3568	-0.6074	-0.0072	-0.1210
LLR bandwidth (0.1)	-0.1254	-1.4684	-0.1176	-1.4237	-0.1153	-1.6262	-0.0219	-0.3849
Program participation before 2005								
Single nearest neighbor	-0.1061	-0.9734	0.0267	0.2330	0.0507	0.4756	0.0149	0.1611
Five nearest neighbor	-0.0073	-0.0850	-0.0251	-0.2798	-0.0015	-0.0157	-0.0151	-0.1720
Caliper (0.05)	-0.0169	-0.1970	-0.0282	-0.3385	-0.0217	-0.2221	-0.0008	-0.0110
Kernel, normal, bandwidth (0.01)	-0.0844	-0.7057	-0.0088	-0.0731	-0.0223	-0.1929	0.0012	0.0127
Kernel, normal, bandwidth (0.1)	-0.0066	-0.0601	-0.0096	-0.0934	-0.0294	-0.2496	-0.0192	-0.1901
LLR bandwidth (0.01)	-0.0765	-0.2980	0.1715	0.6273	-0.0423	-0.1299	0.0970	0.6377
LLR bandwidth (0.1)	-0.0375	-0.3977	-0.0334	-0.3678	-0.0501	-0.5097	-0.0059	-0.0886

Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Table 11 Mean Impact on Labour Cost (2-nurse equivalent)

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	-0.2341	-1.2067	-0.3656	-2.0702*	-0.4175	-2.0218*	0.1428	0.9655
Five nearest neighbor	-0.2131	-1.3277	-0.1460	-0.8968	-0.0961	-0.6302	0.1938	1.5924
Caliper (0.05)	-0.2000	-1.6090	-0.1893	-1.5193	-0.1028	-0.7643	0.1771	1.5347
Kernel, normal, bandwidth (0.01)	-0.2080	-1.1968	-0.2016	-1.1701	-0.0835	-0.4338	0.1685	1.1233
Kernel, normal, bandwidth (0.1)	-0.0749	-0.3837	-0.0589	-0.2933	-0.0701	-0.3415	0.1667	0.9970
LLR bandwidth (0.01)	-0.2068	-0.1948	-0.2012	-0.7859	-0.5168	-2.1889*	0.1674	1.3088
LLR bandwidth (0.1)	-0.1815	-1.2891	-0.1656	-1.1374	-0.1301	-0.9003	0.1928	1.6780*
Program participation before 2005								
Single nearest neighbor	-0.3962	-1.6218	-0.3344	-1.4909	-0.2612	-0.9721	-0.0389	-0.2099
Five nearest neighbor	-0.3137	-1.5362	-0.2713	-1.2968	-0.3148	-1.6127	-0.0696	-0.4118
Caliper (0.05)	-0.3028	-1.6501*	-0.2999	-1.7548*	-0.3299	-1.7327*	-0.0580	-0.3664
Kernel, normal, bandwidth (0.01)	-0.4055	-1.4329	-0.3013	-1.2554	-0.3230	-1.2712	-0.0746	-0.3578
Kernel, normal, bandwidth (0.1)	-0.2456	-1.0140	-0.2046	-0.7958	-0.2649	-0.9925	-0.0300	-0.1439
LLR bandwidth (0.01)	-0.4261	-0.7892	-0.3230	-0.6366	-0.3139	-0.2167	-0.2581	-0.6737
LLR bandwidth (0.1)	-0.3815	-1.8021*	-0.3433	-1.6355	-0.3639	-1.7052*	-0.0377	-0.2243

Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Table 12 Mean Impact on Referred-in Mother

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	0.0012	0.1519	-0.0016	-0.2078	-0.0005	-0.0595	0.0172	2.7302**
Five nearest neighbor	0.0030	0.5085	0.0043	0.7167	-0.0015	-0.2459	0.0205	4.7674**
Caliper (0.05)	0.0027	0.4909	0.0025	0.4386	-0.0015	-0.3061	0.0200	4.5455**
Kernel, normal, bandwidth (0.01)	0.0028	0.4000	0.0020	0.3175	-0.0019	-0.2043	0.0197	3.3390**
Kernel, normal, bandwidth (0.1)	0.0059	0.8082	0.0055	0.6875	-0.0015	-0.2083	0.0199	3.4310**
LLR bandwidth (0.01)	0.0037	0.2741	-0.0002	-0.0052	0.0038	0.1854	0.0200	5.0000**
LLR bandwidth (0.1)	0.0002	0.0385	0.0000	0.0000	-0.0053	-1.2045	0.0203	4.9512**
Program participation before 2005								
Single nearest neighbor	0.0042	0.4242	0.0070	0.7692	-0.0056	-0.6588	0.0170	2.2667*
Five nearest neighbor	0.0060	1.0714	0.0027	0.4355	-0.0131	-2.1129*	0.0119	1.7500*
Caliper (0.05)	0.0058	0.9667	0.0010	0.1316	-0.0080	-1.2308	0.0107	1.5735
Kernel, normal, bandwidth (0.01)	0.0021	0.2283	0.0045	0.4455	-0.0084	-0.8155	0.0122	1.6053
Kernel, normal, bandwidth (0.1)	0.0048	0.5333	0.0023	0.2110	-0.0078	-0.9070	0.0107	1.4459
LLR bandwidth (0.01)	0.0019	0.1387	0.0073	0.1794	-0.0044	-0.1257	0.0123	0.4695
LLR bandwidth (0.1)	0.0021	0.2789	-0.0004	-0.0506	-0.0151	-2.4355**	0.0105	1.6154

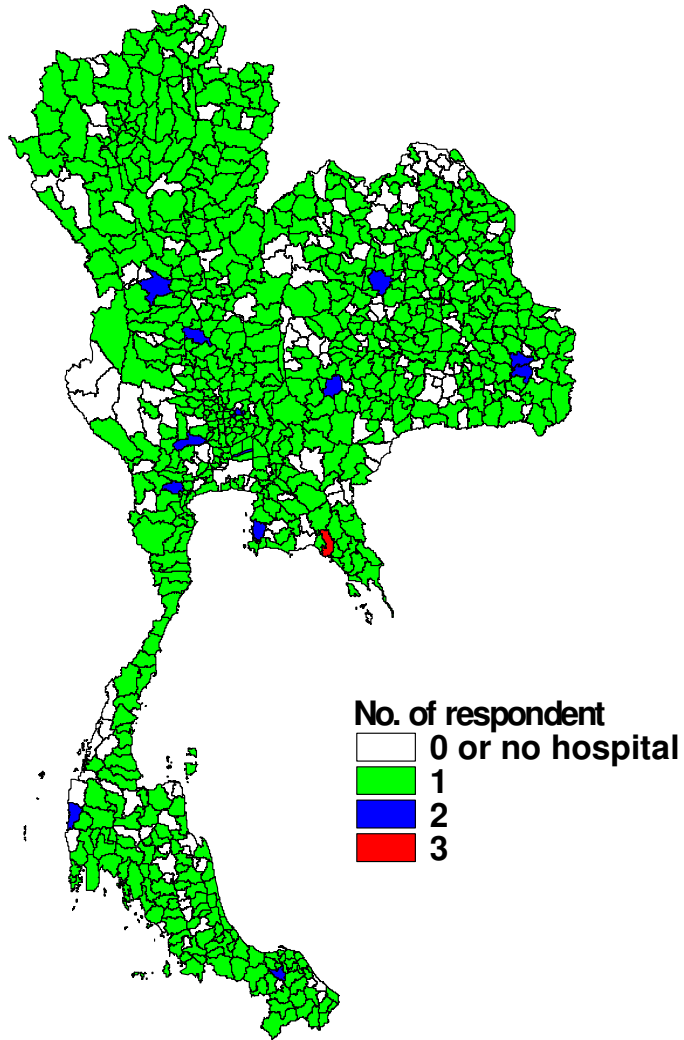
Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Table 13 Mean Impact on Refer-out Mother

Matching and Weight	Total hospital				Community hospital			
	Before the balancing test		After dropping variables that do not pass the balancing test		Before the balancing test		After dropping variables that do not pass the balancing test	
	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics	ATET	t- statistics
Program participation before 2004								
Single nearest neighbor	-0.0134	-0.7746	-0.0076	-0.3878	-0.0428	-2.4181**	-0.0433	-2.7233**
Five nearest neighbor	-0.0245	-1.7254	-0.0199	-1.3007	-0.0317	-2.2971*	-0.0446	-3.2319**
Caliper (0.05)	-0.0162	-1.5728	-0.0167	-1.6058	-0.0323	-2.9099**	-0.0457	-4.3942**
Kernel, normal, bandwidth (0.01)	-0.0146	-0.8066	-0.0162	-0.9000	-0.0284	-1.5026	-0.0450	-2.5862**
Kernel, normal, bandwidth (0.1)	-0.0250	-1.3021	-0.0250	-1.5060	-0.0283	-1.7256*	-0.0460	-2.6136**
LLR bandwidth (0.01)	-0.0132	-0.3235	-0.0166	-0.7905	-0.0228	-0.5416	-0.0478	-3.5147**
LLR bandwidth (0.1)	-0.0176	-1.4426	-0.0176	-1.4426	-0.0256	-2.1880**	-0.0466	-4.3962**
Program participation before 2005								
Single nearest neighbor	-0.0116	-0.5524	-0.0196	-0.8829	-0.0114	-0.6441	-0.0125	-0.9191
Five nearest neighbor	-0.0137	-0.8896	-0.0134	-0.8323	0.0030	0.2098	-0.0171	-1.1477
Caliper (0.05)	-0.0155	-0.8729	-0.0142	-0.7594	-0.0089	-0.6181	-0.0138	-1.1129
Kernel, normal, bandwidth (0.01)	-0.0122	-0.5596	-0.0197	-0.9292	-0.0015	-0.0725	-0.0148	-0.8222
Kernel, normal, bandwidth (0.1)	-0.0096	-0.4384	-0.0100	-0.4608	-0.0074	-0.3474	-0.0176	-0.9832
LLR bandwidth (0.01)	-0.0107	-0.1172	-0.0236	-0.4720	-0.0039	-0.0523	-0.0004	-0.0072
LLR bandwidth (0.1)	-0.0076	-0.4606	-0.0062	-0.3543	0.0003	0.0188	-0.0136	-1.0382

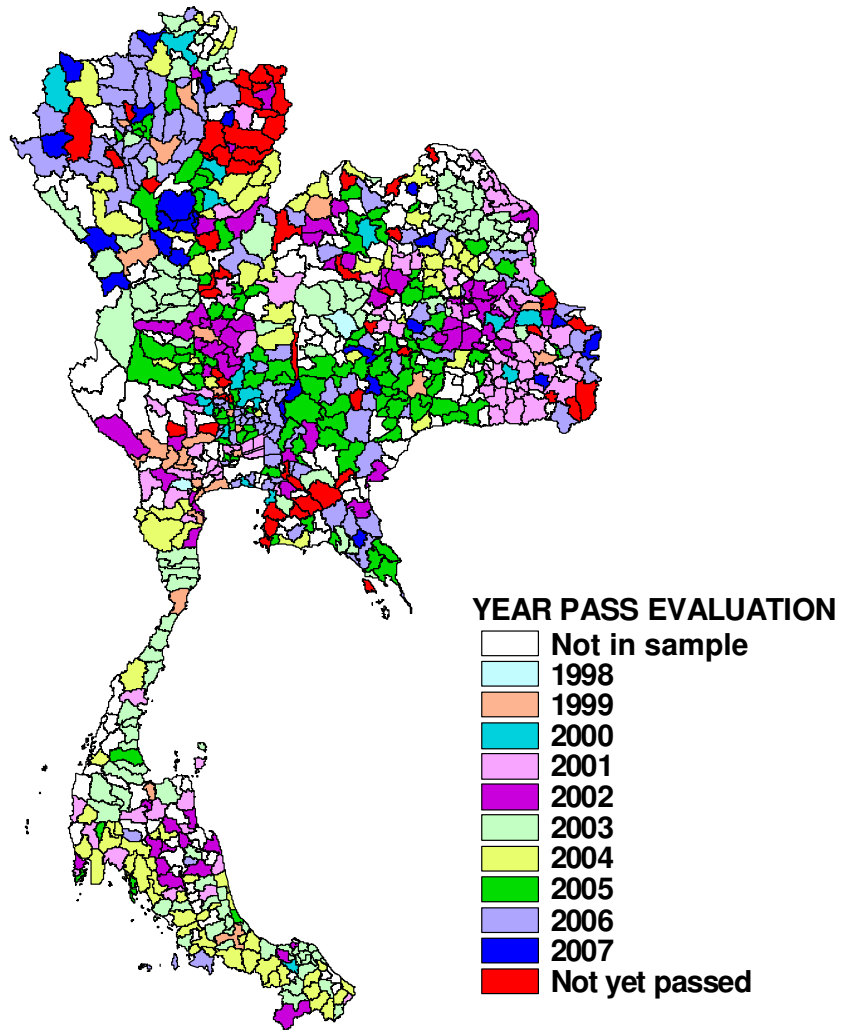
Note: t-statistics is calculated using bootstrap standard errors. * for p<0.05 and ** for p<0.01

Figure 1 Response from the Hospital Survey



Note: Total of 712 hospitals.

Figure 2 Year Pass Process Evaluation



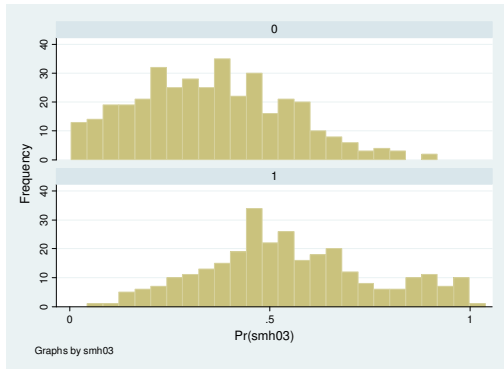
Note: Total of 712 hospitals.

In districts where there are two or three public hospitals, we show only the first-passed hospital.

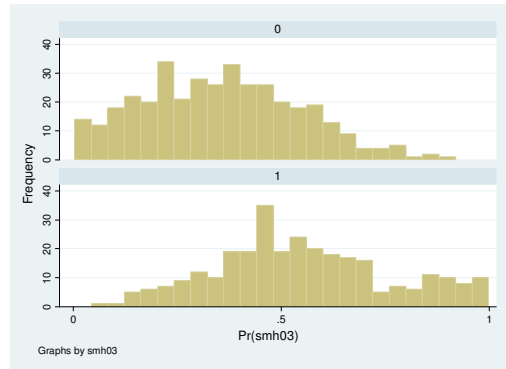
Figure 3 Distribution of $P(X_i)$ from probit estimates in table 6

(a) Total sample

Before the balancing test

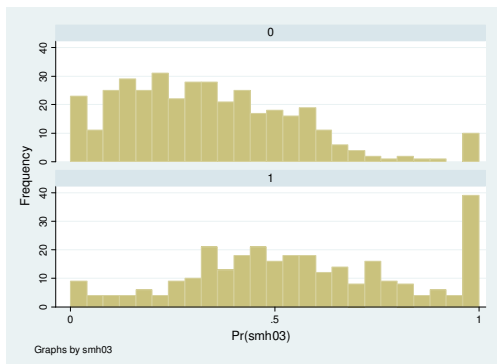


After dropping variables that do not pass the balancing test



(b) Community hospital

Before the balancing test



After dropping variables that do not pass the balancing test

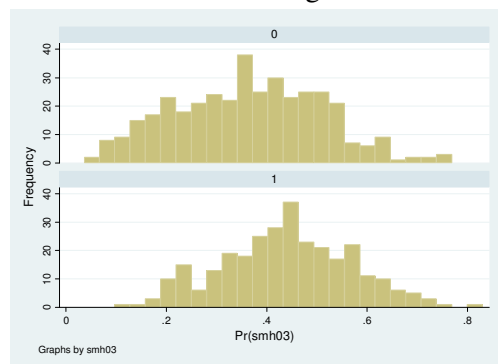
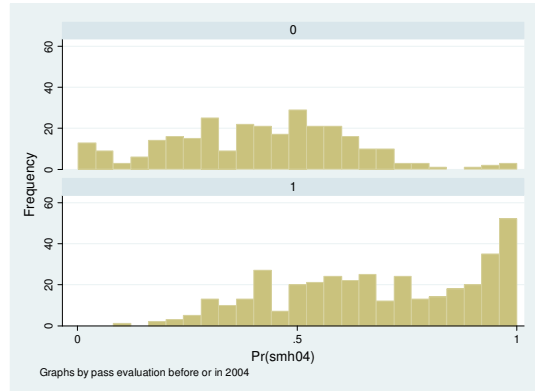
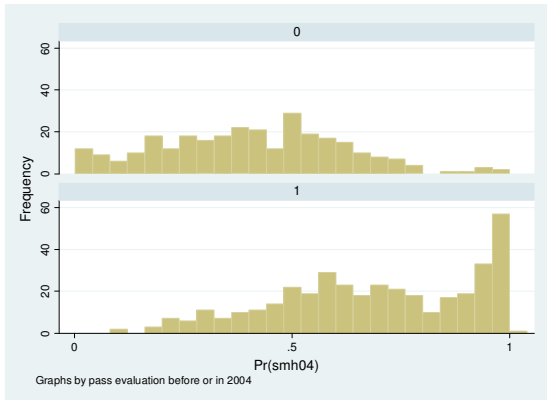


Figure 4 Distribution of $P(X_i)$ from probit estimates in table 7

(a) Total sample

Before the balancing test

After dropping variables that do not pass the balancing test



(b) Community hospital

Before the balancing test

After dropping variables that do not pass the balancing test

