

## Original Article



## Calculating the Number of Pregnant Women Receiving Standardized Services for PMTCT of HIV in Liangshan Prefecture, Based on the Equivalent Method\*

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### Abstract

**Objective** To calculate the number of pregnant women who receive standardized prevention of mother-to-child transmission (PMTCT) services for HIV annually.

**Methods** HIV-positive pregnant women in six counties of Liangshan Prefecture in 2017 were selected as study subjects. The entire process, from when the subjects first received the PMTCT of HIV services to the end, was divided into four stages, which were further divided into 25 phases. The equivalent coefficient was used to indicate the weight of workload in each phase. Seven experts were invited to score the equivalent coefficient; the number of pregnant women who received standardized services to prevent the transmission of HIV was calculated.

**Results** A total of 663 HIV-positive pregnant women were registered in six Liangshan Prefecture counties in 2017. This figure was converted into 7,780 person-months devoted to HIV-positive pregnant women, with 260 person-months (3.34%) spent on the first antenatal care, 1,510 person-months (19.41%) during pregnancy, 378 person-months (4.86%) on delivery, and 5,632 person-months (72.39%) on post-partum period. The equivalent coefficient calculation showed that 314 HIV-positive pregnant women received standardized PMTCT services.

**Conclusion** The number of pregnant women receiving standardized services for the PMTCT of HIV can be calculated accurately using the equivalent method to identify the gap between the level of PMTCT of HIV intervention services needed and the actual workload.

**Key words:** Equivalent method; Standardized services; PMTCT; Pregnant women; HIV

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### INTRODUCTION

In June 2015, Cuba became the first country in the world to be certified by the World Health Organization (WHO) for eliminating mother-to-child transmission (EMTCT) of HIV. Subsequently, Thailand, Belarus, Armenia, and several other countries were certified by the WHO for EMTCT of HIV<sup>[1]</sup>. In recent years, to prevent mother-to-child

transmission (PMTCT) of HIV, syphilis, and the hepatitis B virus, the Chinese Government has invested more than one billion RMB per year and developed interventions programme for PMTCT of HIV, syphilis, and hepatitis B. Standardized intervention services for PMTCT of HIV should cover the following: HIV testing for pregnant women, CD4<sup>+</sup> T cell and HIV viral load testing for pregnant women, free antiretroviral therapy or prophylaxis for

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pregnant women, safe midwifery, antiretroviral prophylaxis for 6 or 12 weeks for children, HIV testing for children, practical guidance on infant feeding, follow-up medical visits, and other interventions<sup>[2,3]</sup>. The duration of standardized services for PMTCT of HIV, from the start of antenatal care (ANC), when a woman is 12 weeks pregnant, to the baby's last medical visit at up to 18 months of age, could be 25 months.

Although the rate of MTCT of HIV in China decreased from 34.8% without intervention (before 2005) to 4.5% in 2018<sup>[4]</sup>, this did not meet the WHO's standard for EMTCT of HIV<sup>[5]</sup>. The rate of MTCT of HIV varied enormously across China's regions. By 2011, the rate had already fallen to 1.2%<sup>[6]</sup> in some regions of China. In Liangshan prefecture, Sichuan Province, where the number of HIV-positive pregnant women has accounted for approximately 10% of the national total in recent years, the rate in 2016 was 9.02%, as compared to 5.7% in China and 7.79% in Sichuan province.

The number of HIV-positive pregnant women who initially received PMTCT services during or post-partum in Liangshan prefecture accounted for 57.47% of the overall number of HIV+ pregnant women<sup>[7]</sup>. Among pregnant women, the level of knowledge and awareness of PMTCT of HIV was low<sup>[8]</sup>. While investigating Liangshan prefecture, Sun et al.<sup>[9]</sup> found that 53.4% of 200 HIV-positive pregnant women received their first prenatal examinations during the later stages of pregnancy (29 gestational weeks, on average). In addition, 26% of HIV-positive pregnant women received no PMTCT intervention services during pregnancy; 38% of pregnant women were tested for HIV before pregnancy, while 43% were tested during and post-partum<sup>[9]</sup>.

As the above-mentioned study shows, a low percentage of HIV-positive pregnant women in Liangshan Prefecture received PMTCT intervention services during pregnancy. Therefore, we propose the hypothesis that fewer HIV-positive pregnant women receive standardized services for PMTCT of HIV than are registered annually. This study introduces the equivalent method in cost accounting<sup>[10]</sup> to test this hypothesis.

## STUDY SUBJECTS AND METHODS

### Study Subjects

The study subjects were HIV-positive pregnant women in six Liangshan prefecture counties in 2017.

The subjects were diagnosed as HIV-positive between January 1 and December 31, 2017, as registered in the National Information System of Prevention of Mother-to-child Transmission of HIV, Syphilis, and HBV Management. These data were downloaded on March 25, 2019.

### Division of the Standardized PMTCT-intervention-service Phase

In accordance with the PMTCT of HIV interventions in the *Implementation Plan for the Prevention of Mother-to-child Transmission of AIDS, Syphilis, and HBV (2015)*, this study has divided the PMTCT-intervention-service phase into four stages: 'first antenatal care', 'pregnancy', 'delivery', and 'post-partum'. These stages have been further divided by month into 25 phases.

When pregnant women receive standardized PMTCT intervention services, the entire PMTCT intervention begins when they are 12 weeks pregnant and ends 18 months after delivery. The intervention duration for each pair of pregnant women and their babies lasted approximately 25 months; P1–P25 were used to represent the 1–25 phases, from the beginning to the end of the PMTCT intervention, respectively.

### Calculation of the Equivalent Coefficient

The equivalent coefficient of the entire standard intervention phase was set to '100%', while the equivalent coefficient of each phase was calculated in proportion to the workload to represent the weight of the intervention phase of the entire PMTCT intervention. Seven experts on PMTCT of HIV, including four from Liangshan prefecture and three from Yunnan province, were invited to score the equivalent coefficient for each phase. The average score was taken as the equivalent coefficient of each phase.

### Method of Calculating the Number of Pregnant Women Receiving Standardized PMTCT Services

The method used to calculate the number of pregnant women receiving standardized PMTCT services annually was as follows:

First, divide the standardized PMTCT intervention service phase into  $P_{i=25}$  phases (with  $i$  representing the intervention phase);

Second, calculate the number of person-months of intervention were provided to pregnant women who received monthly PMTCT services during each phase, then aggregate the number into a yearly figure,  $N_i$ ;

Third, calculate the equivalent coefficients ( $W_i$ ) of the phases using the Delphi method.

The formula for calculating the number of pregnant women who received standardized PMTCT services ( $N$ ) was the sum-product of  $N_i$  and  $W_i$ :

$$N = \sum_{i=1}^{25} N_i \times W_i$$

## RESULTS

### *Distribution of HIV-Positive Pregnant Women Who Began Receiving the PMTCT Intervention*

In 2017, overall, 663 HIV-positive pregnant women in six counties of Liangshan Prefecture were registered with the National Information System of Prevention of Mother-to-child Transmission of HIV, Syphilis, and HBV Management. In this system, the number of HIV-positive pregnant women who first received PMTCT services during early antenatal care, during pregnancy, on delivery, and post-partum accounted for 1.06%, 38.16%, 53.70%, and 3.77% of the total, respectively. In addition, 3.32% of pregnant women volunteered to terminate their pregnancies. Subsequently, we calculated the number of person-months during which HIV-positive pregnant women received PMTCT interventions for each phase. Interventions were conducted for 7,780 person-months, of which 260 (3.34%) were for the first antenatal care, 1,510 (19.41%) during

pregnancy, 378 (4.86%) on delivery, and 5,632 (72.39%) on post-partum period (Table 1).

### *Equivalent Coefficient of the PMTCT Intervention Phase*

The equivalent coefficients for the first antenatal care, pregnancy, delivery, and post-partum periods were 0.105, 0.290, 0.188, and 0.417, respectively. For more details, see Table 2.

### *Calculation of the Number of Pregnant Women Receiving Standardized PMTCT Services*

These figures can be obtained by transposing the data in Tables 1 and 2 into the formula in 1.4, which shows that a total of 314 HIV-positive pregnant women received standardized PMTCT services in 2017. This number was 349 less than 663, the total number of HIV-positive pregnant women registered that year.

## DISCUSSION

For the first time, this study has used the equivalent method in cost accounting to calculate the number of pregnant women who receive standardized PMTCT intervention services annually. This method makes it possible to calculate the use of intervention services, straddling years. In cost accounting, the equivalent method is generally used to convert the degree of completion of finished and unfinished products to the equivalent output of

**Table 1.** The number of pregnant women receiving PMTCT services monthly for each phase

| PMTCT stage          | Period | Number of person-months of intervention | PMTCT stage | Period | Number of person-months of intervention |
|----------------------|--------|---|-------------|--------|---|
| First antenatal care | P1     | 260                                     | Post-partum | P14    | 331                                     |
|                      | P2     | 269                                     |             | P15    | 331                                     |
|                      | P3     | 255                                     |             | P16    | 338                                     |
| Pregnancy            | P4     | 245                                     |             | P17    | 341                                     |
|                      | P5     | 241                                     |             | P18    | 331                                     |
|                      | P6     | 248                                     |             | P19    | 322                                     |
|                      | P7     | 252                                     |             | P20    | 231                                     |
| Delivery             | P8     | 378                                     |             | P21    | 333                                     |
|                      | P9     | 376                                     |             | P22    | 329                                     |
|                      | P10    | 371                                     |             | P23    | 326                                     |
| Post-partum          | P11    | 343                                     |             | P24    | 325                                     |
|                      | P12    | 338                                     |             | P25    | 323                                     |
|                      | P13    | 343                                     |             |        |   |
| Total                |        | 3,919                                   | Total       |        | 3,861                                   |

finished products (i.e. the equivalent output) across departments; production costs are then allocated in proportion to products<sup>[10]</sup>. In the health-care field, this method is used to calculate the cost of illness<sup>[11]</sup> and community health-service projects<sup>[12,13]</sup>, as well as to measure the 'standard work equivalent' of community public health and basic medical care projects<sup>[14]</sup>.

To ensure that the equivalent coefficient accurately represented the current situation in Liangshan prefecture, the seven experts who carried out the equivalent scoring were all experienced staff members of PMTCT intervention services. Four were from Liangshan prefecture and three were from prefectures or counties in Yunnan province. The experts from Yunnan province were invited because Liangshan prefecture is similar to Yunnan province in many ways, ranging from similar HIV epidemics, to the PMTCT of HIV, and economic and natural conditions<sup>[15,16]</sup>.

According to results calculated using the equivalent method, a total of 314 HIV-positive pregnant women (and their babies) received standardized PMTCT services in 2017. This number was 349 (52.64%) less than 663, the total number of HIV-positive pregnant women registered that year, thus testing the hypothesis. The equivalent method can be used to analyze the difference between the number of HIV-positive pregnant women registered and the number of pregnant women who actually receive standardized PMTCT services. This difference

can be used to analyze whether PMTCT of HIV intervention services are actually delivered. It also provides accurate numbers, which can be used to design accurate budgets.

Globally, 18.8 million (16.4 million to 21.7 million) women were living with HIV in 2018<sup>[17]</sup>. In the absence of any intervention, the rate of MTCT of HIV ranges from 14% to 48%<sup>[18]</sup>, while with effective interventions, the rate can be reduced to 5% or 2%, depending on whether the woman is breastfeeding. These rates meet the criteria for WHO validation of EMTCT of HIV<sup>[19]</sup>. In 2017, a pilot project to EMTCT of HIV was launched by the Chinese government in Zhejiang, Guangdong, and Yunnan provinces. In Liangshan prefecture, Sichuan province, where the number of HIV-positive pregnant women has accounted for 10% of the national total in recent years, the rate of MTCT of HIV was 9.02% in 2016, much higher than the national rate of 5.7% in the same year. Within China, the PMTCT of HIV in Liangshan prefecture has been the main focus and concern. Previous research has shown that the rate of MTCT of HIV among pregnant women in Zhaojue and Butuo counties, Liangshan prefecture, was 3.4% (in 2011) and 10.3% (in 2012)<sup>[20]</sup>, a high level of prevalence by worldwide standards<sup>[21]</sup>. Research has shown that 77.9% of pregnant women in Liangshan prefecture know that ANC is very necessary and 94.6% of pregnant women are willing to receive it, but only 24.2% actually receive it, due to issues such as shyness, lack of independence, and lack of

**Table 2.** Equivalent coefficient of PMTCT intervention period

| PMTCT stage          | Period | Equivalent coefficient | PMTCT stage | Period | Equivalent coefficient |
|----------------------|--------|------------------------|-------------|--------|------------------------|
| First antenatal care | P1     | 0.105                  | Post-partum | P14    | 0.025                  |
|                      | P2     | 0.030                  |             | P15    | 0.016                  |
|                      | P3     | 0.041                  |             | P16    | 0.022                  |
|                      | P4     | 0.045                  |             | P17    | 0.016                  |
| Pregnancy            | P5     | 0.034                  |             | P18    | 0.008                  |
|                      | P6     | 0.056                  |             | P19    | 0.035                  |
|                      | P7     | 0.084                  |             | P20    | 0.019                  |
| Delivery             | P8     | 0.188                  |             | P21    | 0.008                  |
|                      | P9     | 0.083                  |             | P22    | 0.008                  |
|                      | P10    | 0.060                  |             | P23    | 0.008                  |
| Post-partum          | P11    | 0.018                  |             | P24    | 0.008                  |
|                      | P12    | 0.010                  |             | P25    | 0.046                  |
|                      | P13    | 0.027                  |             |        |                        |
| Total                | 0.781  | Total                  | 0.219       |        |                        |

money<sup>[22]</sup>. This study provides more accurate data, confirming the above-mentioned research findings.

The limitations of this study include the following two points: first, although seven experts carried out the equivalent scoring, all of them were from Liangshan prefecture and Yunnan province. Second, in relation to the number of pregnant women receiving standardized intervention services, only the phases and equivalent coefficient of the PMTCT intervention services were discussed. Intervention quality was not taken into account.

### AUTHORS' CONTRIBUTIONS

Author contributors: ZHANG Tong and WANG Ai Ling designed all aspects of the study, including the study protocol. QU Shui Ling analyzed the data and wrote the first draft of the manuscript. WANG Ai Ling organized experts to rate the equivalent coefficient. PAN Xiao Ping and LUO Hui Ming revised the manuscript. WANG Xiao Yan participated in data management. All the authors read and approved the final manuscript.

### CONFLICTS OF INTERESTS

The authors have no conflicts of interest to declare.

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