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The equivalent value (EV)-based workload assessment of primary healthcare workers in Beijing, China

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Abstract

Background Quantitative methods for estimating the workload of primary healthcare (PHC) workers are essential for improving the performance of PHC institutions. However, measuring the workload of PHC workers is challenging due to the diverse and complex range of services covered by PHC. This study aims to use an equivalent value (EV)-based approach to assess the workload of PHC workers and inform policymakers about the current workload burden in Beijing, China.

Methods The EV-based workload assessment system was designed by three main steps: identifying the list of essential PHC service items provided by PHC workers, quantifying the EV of each service item, and calculating the corresponding workload for PHC workers and community health centers (CHCs). The study included 18 CHCs, which were divided into three groups based on population density and topography: Group I (eight urban CHCs), Group II (six CHCs in semi-mountainous areas), and Group III (four CHCs in mountainous areas). Data were collected from local health information system, which automatically collected real-time service volume data for 500 PHC service items at 18 CHCs in the sample district in Beijing from 2017 to 2021.

Results This study identified 503 essential PHC service items and defined their EVs. The theoretical full-capacity workload per PHC worker was 6024 EVs, serving as the base workload. The actual annual workload per PHC worker was 7240.0 EVs during 2017–2021. The base workload per budgeted position for the three types of CHCs was 6468.6 EVs for Group I, 5268.5 EVs for Group II, and 5038.7 EVs for Group III. Compared with the actual workload of 7702.3 EVs, 6568.3 EVs, and 5979.0 EVs in each group, respectively, all PHC workers in the sample district were overburdened during the study period.

Conclusions The EV-based method provides a feasible solution for comprehensively assessing the workload of publicly funded PHC institutions in other regions. This study offers valuable insights to help local policymakers understand the workload burden of PHC workers, objectively evaluate their performance, and guide future health workforce planning.

Keywords Equivalent value, Workload assessment, Primary health care, China

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Introduction

A well-performed primary health care (PHC) system has been regarded as the key to achieving the goal of "Health For All" worldwide [1]. As the main PHC providers in practice, how to improve the performance of PHC workers may be a necessary condition for the achievement of universal health coverage in the age of Sustainable Development Goals [2]. As one major component, the assessment of workload plays an important role in the performance evaluation system of PHC workers. The workload indicator is also commonly used in the rational planning of health workforce at national or regional level such as the workload indicators of staffing needs (WISN) developed by the World Health Organization (WHO) [3, 4]. The WISN method is based on a health worker's workload, with activity (time) standards applied for each workload component, which has been employed in the health sector since the late 1990s [3, 4].

A better understanding of PHC workers' workload is an important consideration in establishing optimal size of primary health workforce [5]. Any shortage in staff is associated with an increase in the workload of existing staff (burnout) and, ultimately, the potential risk of committing medical errors and compromising patient safety [6]. Workload related overburden was identified as one of the most commonly correlates of PHC workers' burnout, particularly during the COVID-19 pandemic [7–9]. Therefore, how to scientifically assess the workload of PHC workers has always been a concerning and challenging issue in practice.

However, PHC covers comprehensive and complex medical services and public health services, which produces enormous obstacles to quantifying the workload assessment of PHC workers. There is much less empirical evidence on how to estimate the workload in the domain of PHC. WHO–WISN method was mostly used [5, 6], which uses annual services to assess workloads [4]. The problem with the WISN approach is the static and narrowly focused model, which could be weak at reflecting the characteristics of diversified PHC service items. In this study, we aim to introduce the concept of "standardized workload or equivalent value" into the workload assessment of PHC, namely, "EV-based workload assessment". The two concepts of "equivalent value" and "standardized workload" are consistent with the resource-based relative value scale (RBRVS) proposed by the United States in 1992, which is based on resource input, or the quantification standard of the "relative value" of different medical and public health service items. The EV-based workload estimation method considers factors, such as working hours, technical content, work difficulty and operating risk. Therefore, it is in line with the essence of "performance" and can comprehensively reflect the overall workload of PHC workers and PHC institutions.

In China, the PHC institutions include township-health centers and village clinics in rural area and community health centers (CHCs) and community health stations in urban area [10]. The majority of PHC institutions are fully financed by the government, which provides a solid guarantee of their operation and development [11, 12]. Under this budget system, the income and expenditure of PHC institutions are managed in separate streams; that is, revenue goes to the treasury, and expenditure is financed by fiscal allocations [13]. The government budget is allocated based on the number of budgeted positions at PHC institutions and is not related to the service actually provided. Therefore, some unavoidable challenges have emerged that hinder the development of PHC institutions [14, 15]. For example, PHC institutions now face diversified service needs and vaguely defined service boundaries. Furthermore, the incentive mechanism is weak, because the income of workers is not directly linked to their workload, and some have been seriously understaffed for years [13, 16, 17].

In the New Health Care Reform initiated in 2009, several important national policies were released to stimulate the comprehensive reform of PHC in practice [18–20]. In particular, the document "Opinions on Further Promoting and Deepening the New Health Care Reform" in 2016 by the China State Council (CSC) proposed to "improve the performance evaluation system based on the standardized workload or equivalent value". Guided by these national policies, local governments have actively piloted an EV-based workload assessment for PHC institutions in China. The main content of the reform is to define and establish the "equivalent value" of PHC service items. The EV-based methods have been piloted to estimate the cost of National Essential Public Health Services Package [21], to calculate community health-staffing requirements [22] and to assess the workload of village doctors in the specific National Essential Public Health Services Program [23], which provided firm basis for the exploration and application of EV-based workload assessment to PHC workers.

This study aims to analyze the pilot practice of an EV-based workload assessment method during the 5-year period of 2017–2021 in Beijing, China. Our findings would serve as an important reference for scientific evaluation of workload, health workforce planning and performance evaluation system in the area of PHC in other regions of China and other countries. Specifically, we intend to answer the following three research questions that are closely related to the workload estimation of PHC workers:

i. How can the service boundary of PHC institutions and related EVs be defined?
ii. What are the actual workload of PHC workers?
iii. How can the base workload of PHC institutions to be set (i.e., the goal to be achieved for each PHC institution)?

Data and methods

Study setting

This study was conducted in Changping District (the sample district), Beijing. In 2016, Changping District initiated the comprehensive reform of PHC to improve the performance of PHC institutions. The EV-based workload assessment method was set as one of the core components of this reform, which has been implemented since 2017.

Changping District is located in northwestern Beijing. Its total area is around 1200 square kilometers, with 60% mountainous area and 40% plain area. There are 15 towns, 301 administrative villages, and 235 neighborhood committees under its jurisdiction [24]. There are 18 CHCs to provide PHC from 2017 to 2021. According to the population density and topography of the service area, the 18 CHCs fall into three groups: Group I consists of eight urban CHCs, Group II consists of six CHCs located in semi-mountainous areas, and Group III consists of four CHCs in mountainous areas. The socio-demographic information including total population, percentage of population above 65 years and service area covered by each group of CHCs is shown in Table S1 (Additional file 1), indicating the diversified characteristics in each group of CHCs. Therefore, the EV-based workload assessment to PHC workers was set for each group of CHCs, respectively.

There are two types of health workforce based on the status of budgeted positions (called "bianzhi" in Chinese), that is, budgeted position staff (with a fully fiscal subsidy) vs. fixed-term staff (contracted with CHCs and paid by the revenue of CHCs). Therefore, the active staff (the number of staff in service) in this study is the sum of both staff with budgeted positions and fixed-term staff. Table 1 shows the number of health workers in Changping District, Beijing, from 2017 to 2021. During the 5-year period, the number of active staff of CHCs in Changping increased with a growth rate of 13.90%.

The EV-based workload assessment method

Clarify the service scope of PHC institutions and identify the list of essential PHC service items

First, all types of PHC services provided in CHCs were investigated and divided into five categories: essential medical services, nursing services, pharmacy services, auxiliary examination services and public health services. A multistage iterative feedback and revision process was conducted, and a series of four meetings were held with participants based on their knowledge and expertise about PHC and their groups (Group I, Group II, and Group III). The participants included heads of CHCs ($n=18$), family physicians ($n=36$), nurses ($n=18$), and public health workers ($n=18$). A list of essential service items provided in CHCs was developed, and the procedures and contents of each service item were identified according to the Protocol for National Essential Public

Table 1 Health workforce of CHCs in Changping District in 2017–2021

	2017	2018	2019	2020	2021
Number of active staff (person)	1842	1932	1984	1993	2098
Group I CHCs	1206	1272	1327	1329	1371
Group II CHCs	400	401	397	401	454
Group III CHCs	236	259	260	263	273
Number of budgeted positions (person)	1517	1544	1548	1575	1591
Group I CHCs	966	987	1000	1032	1041
Group II CHCs	349	350	346	338	344
Group III CHCs	202	207	202	205	206
Number of fixed-term staff (person)	325	388	436	418	507
Group I CHCs	240	285	327	297	330
Group II CHCs	51	51	51	63	110
Group III CHCs	34	52	58	58	67
Percentage of fixed term staff in total staffs (%)	17.64	20.08	21.98	20.97	24.17
Group I CHCs (%)	19.90	22.41	24.64	22.35	24.07
Group II CHCs (%)	12.75	12.72	12.85	15.71	24.23
Group III CHCs (%)	14.41	20.08	22.31	22.05	24.54

Health Services [25], the Standards for Community-Level Health Care Services Beijing [26], and interviews with CHC directors and on-site surveys.

Quantify the "equivalent value" (EV) of each CHC service item

EVs are mainly affected by four factors, namely, person-time per unit of service, level of skill needed, degree of difficulty, and risk of the service. A standard clinic visit was introduced as a benchmark for other services and defined as a family physician consulting with one patient for 15 min. The workload of a standard clinic visit was defined as one "EV". EVs of all other CHC services were calculated based on interviews with CHC directors, officials from competent administrations and PHC workers. Given the impact of topography on the EV, three sets of EV standards were developed for the CHCs in Group I, Group II, and Group III.

In this study, Annual EV of services per PHC worker = ∑Annual total EVs of services/Number of active staff. The annual total EVs of services = ∑EV standard × Annual service volume (i.e., actual workload in practice).

Calculating the base workload of PHC institutions

a. Full-capacity workload (effective service capacity per annum in theory) = effective working days per annum × maximum daily working hours × 60 min/time of a standard clinic visit (15 min). The number of effective working days per annum is approximately 251 days, excluding weekends and holidays. Maximum daily working hours refers to the maximum effective working hours in a day, excluding regular off hours and time for meals, drinking water, and restrooms. Therefore, full-capacity workload (effective service capacity per annum in theory) = 6 h × 251 days × 60 min/15 min = approximately 6,024 EVs of services.
b. Total base workload of CHCs in the district = Base workload per PHC worker × Number of budgeted positions. The study compared the two per capita indicators calculated above ("Annual EV of services per PHC worker" vs. "Full-capacity workload") and chose the lower one as the base workload per capita.
c. Base workload per PHC worker in each group of CHCs (i.e., Group I, Group II, Group III) = total base workload of CHCs in the district × historical share of the workload of this group/number of budgeted positions in this group. The base workload was uniform for CHCs in the same group but varied for those in different groups. The base workload of each group was determined by its historical workload as a share of the total.

Data collection and analysis

Data were collected from Changping District's health information system. The information system automatically collects real-time service volume data for 500 PHC service items in 18 CHCs. It can avoid errors caused by manual reporting and increase the timeliness, reliability and accuracy of the data. Specifically, the variables used in this study included the number of budgeted staff positions, number of active staff, and volume of each PHC service item in 18 CHCs during the 2017–2021 period. Descriptive statistics were adopted. Stata 16 for Windows (Stata Corp, College Station, TX, USA) software was used for statistical analysis.

Results

Essential PHC service items and their EVs

The study identified 503 items of essential PHC services and calculated their EVs. It covered essential medical services (293 items), nursing services (28 terms), pharmacy services (8 items) or auxiliary examination services (31 items), and essential public health services (143 items of national and local public health services). Table 2 shows part of the essential PHC service items (as representative) and their related EV assignment.

The annual EV of services per PHC worker

Figure 1 shows the annual EVs of all PHC workers in Changping District from 2017 to 2021. It illustrates the total actual workload of CHCs in this district, which demonstrates an upward trend with a growth rate of 30.6% from 2007 to 2021. Specifically, Group I CHCs experienced the highest growth rate of 34.6%, while Group II and Group III CHCs saw similar increases of 21.9% and 21.4%, respectively. However, the total actual workload in 2020 was slightly lower than that in 2019, with an overall decline of 10% when excluding the two newly established CHCs.

Figure 2 shows the annual EV of services per PHC worker in Changping District, which rose by 14.7% from 2017 to 2021. The 5-year average (2017–2021) was 7240.0 EVs. During this period, all three groups of CHCs reported an increase. Group I CHCs delivered the highest amount of services, while Group III CHCs provided the fewest. However, the annual EVs of services per PHC worker in 2020 were lower than that in 2019, with a decline of 7.61%.

The detailed data for Figs. 1 and 2 can be found in Table S2 in Additional file 1. The proportion of annual EVs and total EVs of PHC workers in the three groups

Table 2 Essential PHC service items and related EV assignments in Changping District

Categories	Essential PHC service item	Unit	EV assignment (unit: EV)		
			Group I	Group II	Group III
Essential medical services	Clinic visit (per visit)	Per visit	1	1	1
	TCM clinic (per visit)	Per visit	1.2	1.2	1.2
	Pediatric clinic (per visit)	Per visit	1.5	1.5	1.5
	Home visit	Per visit	5	7	9
Nursing services	Subcutaneous injection	Per time	0.6	0.6	0.6
	Intravenous injection	Per time	1	1	1
	Intramuscular injection	Per time	0.6	0.6	0.6
	Change dressings (TCM)	Per time	2	2	2
Pharmacy service	Filling of prescription (Western medicine)	Per prescription	0.2	0.2	0.2
	Filling of prescription (TCM ready-to-use forms)	Per prescription	0.8	0.8	0.8
	Filling of prescription (TCM decoction)	Per prescription	2.2	2.2	2.2
Auxiliary examination	Blood type test	Per test	5	5	5
	Trace element test	Per test	0.8	0.8	0.8
	Blood, urine and stool test	Per test	0.7	0.7	0.7
	Venous blood test	Per test	0.8	0.8	0.8
	Biochemical test	Per test	0.8	0.8	0.8
	B-mode ultrasonography	Per test	1.2	1.2	1.2
	ECG examination	Per test	0.7	0.7	0.7
Essential public health service	New health records established	Copy	2.5	2.5	2.5
	Follow-up evaluation and case management services (hypertension cases)	Per visit	1.7	1.7	1.7
	Follow-up evaluation and case management services (diabetes cases)	Per visit	2	2	2
	Children's health management (telephone follow-up)	Per visit	0.2	0.2	0.2
	Neonate home visits	Per visit	3	5	7
	Case follow-up for 1 month	Per visit	1.8	1.8	1.8
	TCM counseling service for children (6, 12,18, 24, 30, and 36 months)	Per time	0.7	0.7	0.7
	Health management for pregnant women in the first trimester	Per time	1.5	1.5	1.5
	Health management for pregnant women in the second trimester	Per time	1.5	1.5	1.5
	Health management for pregnant women in the third trimester	Per time	1.5	1.5	1.5
	Physical checkup (covered by essential PHC services)	Per time	0.5	0.8	1.1
	Physical checkup (items not covered by essential PHC services)	Per time	1	1	1
	Number of persons covered by the family doctor contracting services (priority population)	Person	2.1	2.1	2.1
	Number of persons covered by the family doctor contracting services (general population)	Person	0.6	0.6	0.6

Part of the PHC service items were shown for readability

TCM traditional Chinese medicine

from 2017 to 2021 are also provided in Figs. S1 and S2 in in Additional file 1 to further present a comprehensive picture.

The total base workload of CHCs

The average annual workload per PHC worker in Changping District from 2017 to 2021 was 7240.0 EVs. The actual workload of both Group I and Group II CHCs exceeded the theoretical full-capacity workload (6024 EVs). Therefore, the full-capacity workload of 6024 EVs was considered the base workload per capita. The number of budgeted positions for CHCs increased from 1517 in 2017 to 1591 in 2021. Consequently, in 2021, the total base workload of CHCs in the district was calculated as follows:

$$\begin{aligned}&\text{Total base workload}\\&= \text{Base workload per PHC worker(6024 EVs)}\\&\times \text{ Number of budgeted positions(1591)} = 9584184 \text{ EVs.}\end{aligned}$$

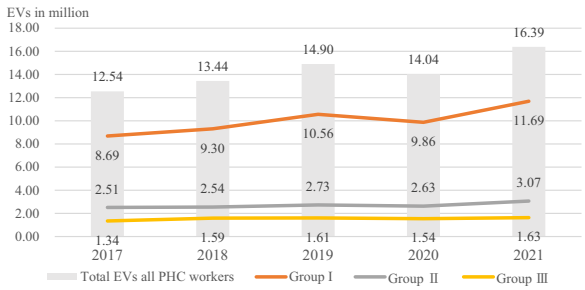

Fig. 1 Total EVs (in million) of all PHC workers in Changping District from 2017 to 2021

The base workload of CHCs in each group

The service share of the three groups of CHCs in relation to the total service volume was 70.3%, 18.9% and 10.8%, respectively, as shown in Table 3. Based on the formula "Base workload of each group of CHCs = Total base workload of the district (9,584,184 EVs) × Historical service share of the workload of the group/Number of budgeted positions in the group", the base workload of the three groups of CHCs was 6468.6, 5268.5 and 5038.7 EVs, respectively, as shown in Table 3.

Comparing these base workloads with the actual workloads presented in Table S2 (7702.3, 6568.3, and 5979.0 EVs), it is clear that all three groups of CHCs were overburdened from 2017 to 2021. The overloads amounted to 1233.7EVs, 1299.8EVs and 940.3 EVs for Group I, Group II, and Group III, respectively.

Table 3 Base workload of CHCs in three groups

	Group I	Group II	Group III
No. of CHCs	8	6	4
No. of budgeted positions	1041	344	206
Share of average workload of 2017–2021	70.26%	18.91%	10.83%
Total base workload (EVs in million)	6.73	1.81	1.04
Base workload per budgeted position (EV)	6468.6	5268.5	5038.7

Discussion

This study explores the EV-based workload assessment method applied in Beijing, China. We identified 503 essential service items of PHC institutions and defined their respective EVs. The full-capacity workload per PHC worker is set at 6024 EVs, which serves as the base workload. The actual annual workload per PHC worker was 7240.0 EVs during 2017–2021. We recommend the following base workload per budgeted position for each CHC: 6468.6 EVs for Group I, 5268.5 EVs for Group II, and 5038.7 EVs for Group III. Corresponding target workload goals for each CHC were established, serving as key performance indicators for practical evaluation. When compared with the actual workload—7702.3 EVs for Group I, 6568.3 EVs for Group II, and 5979.0 EVs for Group III, the findings reveal that all PHC workers in the sample district were overburdened during the study period. The appropriateness of the EV-based workload assessment and its application in the PHC merit further discussion.

First, this study shows the appropriateness of the EV-based workload assessment method for PHC workers.

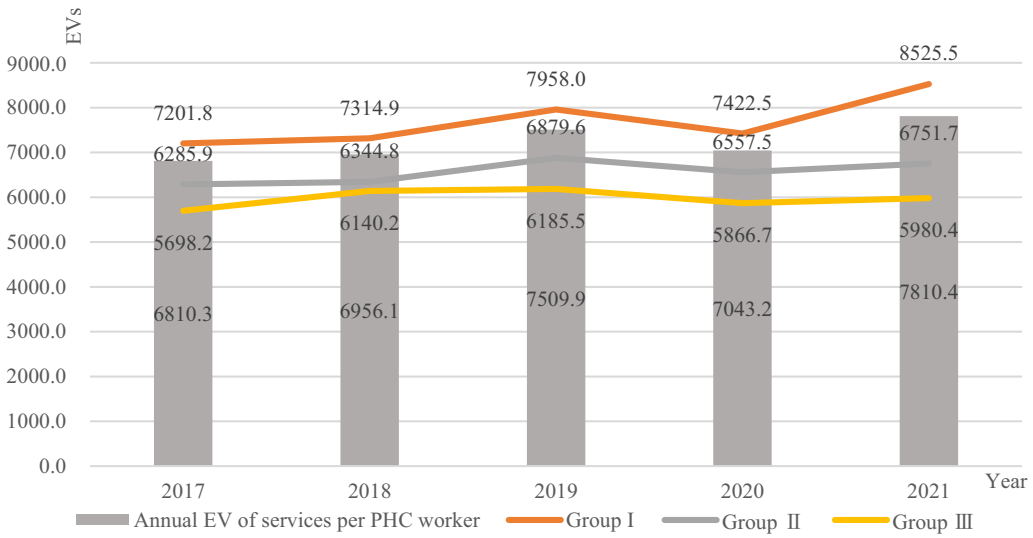

Fig. 2 Annual EV of services per PHC worker in Changping District from 2017 to 2021

To the best of our knowledge, this is the first study to apply the concept of EVs to the workload evaluation in the PHC sector, following our earlier research [21–23]. Assessing the workload in PHC is particularly challenging due to the complex and diverse service content. For example, the workload units in the setting of PHC vary across different service categories, such as outpatient service (measured in person-time), pharmaceutical service (measured in doses), health management of hypertension patients (measured by person), and health consultation activities (measured in instances) [12]. The EV-based workload estimation method addresses these challenges by considering working hours, technical content, work difficulty and operational risk, which are the key determinants of PHC workers' workload and performance. This method offers a unified standard for measuring diverse service items within the PHC setting, quantifying both the target and actual workload of PHC workers.

Publicly funded PHC institutions worldwide face common challenges, such as low incentives, understaffing, and inadequate fiscal subsidies. These issues must be addressed as part of ongoing PHC reform in China. The pilot experience from Beijing, as highlighted in this study, demonstrates that the EV-based methods offers a feasible solution for objectively and comprehensively assessing the workload of publicly funded PHC institutions. This approach could inform the allocation of fiscal subsidies and incentivize PHC workers. It also supports the rational management and distribution of the PHC health workforce by aligning actual workloads with target workloads (base service volume). In addition, the EV concept could be valuable for private PHC institutions, particularly in designing workload-related incentive mechanisms and determining the necessary workforce.

Second, our results indicate that the PHC workers at publicly funded PHC institutions are overburdened and informs the urgent need for a dynamic financial incentive mechanism in practice. This high workload aligns with findings from other studies using questionnaire surveys and qualitative interviews with PHC workers [16, 27, 28]. The Changping case reveals that a financial incentive mechanism for managing extra workload is urgently needed, particularly for health staff in Group I CHCs. A high workload can adversely affect the quality of care and the recruitment and retention of PHC workers [10]. Therefore, the fiscal compensation system for PHC institutions should be adjusted dynamically, based on both the actual workload and the base workload. Moreover, policymakers must strike a balance between quality and efficiency of care to foster the sustainable development of PHC institutions.

Furthermore, this study did not capture the additional workload related to COVID-19 prevention and control activities using the EV method. Therefore, the real workload of PHC institutions is likely higher than our estimates. We also observed a 7.6% decrease in the total workload of CHCs in 2020, primarily due to the outbreak of the COVID-19 pandemic. Many PHC workers were diverted to pandemic control, disrupting their daily operations and negatively impacting PHC institutions efficiency [29]. Future iterations of EV-based evaluation method should incorporate workload data related to public health emergencies, in addition to the routine medical and public health services provided by PHC institutions.

Third, we identified three key steps in the EV-based workload estimation method for PHC areas, which can serve as a reference for other regions. These steps are as follows: (i) essential services, including both public health and medical services, must first be identified, and the EV for each service item should be defined. (ii) The annual workload per PHC worker should be determined, compared with the full-capacity workload (6024 EVs), and the lower workload value should be chosen as the base workload for each CHC. If the actual workload is lower, the CHC is operating below full capacity; if it exceeds the base workload, the CHC is overburdened, and the staff may need to work overtime or compromise care quality. Therefore, the base workload of CHCs should not exceed the full-capacity workload. (iii) The fiscal subsidy or compensating mechanism for PHC institutions should be based on a comparison between the actual workload and the base workload. In addition, local context should be considered, particularly when addressing disparities between rural and urban areas or among different CHCs. For example, we used population density and geographic characteristics in this study to categorize the 18 CHCs into three groups, each with distinct base workloads.

Finally, there are two limitations. First, the EV-based workload assessment method employed in this study requires supporting information systems to provide the necessary data for calculations. However, many regions currently lack information systems capable of meeting these requirements. It needs significant financial investments from local governments to redesign and upgrade their health information systems, which would probably limit the scalability of this approach. Second, this study is based on 503 service items covered by current PHC range. However, the number of PHC service items increases annually, which requires continuous adjustments. Therefore, a key challenge is determining the EV standard for newly added service items.

Conclusion

In this study, an EV-based method is proposed to address the challenges of workload assessment for PHC workers and institutions in China by identifying key PHC service items and quantifying the EV of each. This approach enables local policymakers to gain insights into the workload of PHC workers and objectively assess their performance, ultimately facilitating the efficient allocation of fiscal subsidies.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12960-024-00970-5.

Additional file 1.

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Author contributions
D.Y. and N.W. were responsible for the conception, design and acquisition of data. S.Y. and T.Y. was responsible for analysis and interpretation of the data and drafting the initial manuscript. N.W. and Z.W. critically revised the manuscript for important intellectual content. S.Y. and D.Y. was responsible for reviewing all drafts of the manuscript and giving final approval for the version to be published. All authors read and approved the final manuscript.

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Data availability
No data sets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The study protocol was approved by the Institutional Review Board of the Capital Institute of Pediatrics, Beijing, China (SHERLL number 2016015).

Competing interests
The authors declare no competing interests.

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