BMC Health Services Research

RESEARCH

Open Access

Multidisciplinary DRG management for rational medication in obstetrics: a cost analysis in Zhejiang Province

Qiqin Zhang[1], Geer Zhang[1], Shuangneng Yang[1], Meng Zhang[1], Shujuan Shu[1] and Mengdan Zhao[1*]

Abstract

Background Zhejiang Province introduced diagnosis-related group (DRG) payment reform in 2020, covering all hospitalizations to reduce costs and improve services. However, its emphasis on financial indicators and overlooks the evaluation of medical rationality, especially for pregnant women. To bridge this gap, this study developed an obstetric multidisciplinary team (MDT) model in which pharmacists are integrated into prenatal decision-making. This represents a transformation from reactive cost control to proactive medication optimization.

Methods This study collected DRG data of obstetric patients from a hospital between 2020 and 2024. First, we descripted the overall DRG operational performance and identified OZ13 (Other Pregnancy-Related diseases, with General Complications and Comorbidities) as the target disease groups by the Boston Matrix analysis. Subsequently, we employed Spearman correlation and Kruskal-Wallis H tests to identify key cost drivers. Finally, we applied a generalized linear model with gamma distribution and log-link function to determine key factors influencing medical costs.

Results After the implementation of the multidisciplinary team management, the Time Consumption Index (TCI) decreased from 1.06 to 0.9 and the Cost Consumption Index (CCI) dropped from 1 to 0.91. Meanwhile, the Case Mix Index (CMI) increased to 0.51. The OZ13 group was selected for follow-up analysis using the Boston Matrix analysis because group exhibited decreased average hospitalization expenditure but an increased Cost Consumption Index. OZ13 group analysis revealed hospitalization costs strongly correlated with pharmaceutical costs ($p = 0.81$, $P < 0.01$), with significant expenditure differences between 2020 and 2024 ($P < 0.05$). Furthermore, the generalized linear model identified several factors influencing hospitalization costs for OZ13 patients, including a history of recurrent miscarriage or IVF status, gestational weeks, parity, age, and length of hospital stay.

Conclusions The research findings show that early pharmacist involvement in the multidisciplinary team management has positively impacted hospital functioning, including quality, efficiency, and costs. It identifies pharmaceutical costs as the main adjustable expenditure in OZ13 disease group and highlights the necessity of differentiated management for complex cases.

Keywords DRG payment reform, Multidisciplinary team, Cost analysis, Obstetrics

*Correspondence:
Mengdan Zhao
dreamdan@zju.edu.cn
[1]Women's Hospital, Zhejiang University School of Medicine, 1 Xueshi Road, Hangzhou 310, 006, PR China

Background

The use and management of pharmaceuticals during pregnancy is a critical public health concern. Over 90% of pregnant women use at least one medication during gestation [1], with approximately 29% may be exposed to FDA Pregnancy Category D or X medications [2], which may result in adverse pregnancy and neonatal outcome such as congenital malformations, developmental abnormalities, preterm birth, or miscarriage [3]. One - quarter of medications have insufficient evidence available to characterize their safety profiles during pregnancy, due to the exclusion of pregnant women from clinical trials for fetal protection [4]. Physiological changes during pregnancy alter drug metabolism and clearance [5], necessitating individualized dose adjustments by clinicians, but 82% of the recommendations for medication use during pregnancy are based solely on animal study data [6].

In order to control the unreasonable growth of hospitalization expenses, the National Healthcare Security Administration of China implemented Diagnosis Related Groups (DRG) payment reform in 2019. As a new payment method, DRG is a patient grouping scheme, which can be used to establish standardized evaluation indexes. It has been widely utilized in the evaluation of medical services and can provide standardized tools for assessing output, efficiency, and quality [7]. Additionally, it offers a framework for internal performance assessment within hospitals and facilitates effective hospital management [8]. On 1 January 2020, all inpatient diseases in Zhejiang Province initiated DRG payment reform, which is significant as a reform pilot region in China. According to the 2020 Zhejiang Statistical Annual Report, the average hospitalization expenses decreased from 13, 625 Yuan (About $1,874) to 13,107 Yuan (About $1,803).

China's public hospitals rely on payments from health insurance rather than public funding or financial expenditures. This makes hospital administrators sensitive to changes in how insurance pays for care [9]. This is reflected in the fact that hospitals under DRG payments are required to provide care within a limited payment rate or face the end of self-financed overspending. Previous studies have demonstrated that the DRG payment system reduces unnecessary pharmaceutical expenditures through constraint mechanisms, prompting hospitals to select cost-effective medications. However, it may induce treatment inadequacy risks, physicians might reduce essential drug use for cost containment [10], this phenomenon particularly prominent in traditional Chinese medicine hospitals [11]. Current DRG systems lack obstetric-specific quality indicators, making it difficult to balance cost containment with quality maintenance [12]. Therefore, how to respond to DRG payments through an aggressive cost control model to avoid compromising the rationality of care in order to reduce costs has become a key point for hospitals to explore.

The establishment of multidisciplinary management teams has become a proactive response for hospitals to reduce healthcare expenditures(The composition of the team and the distribution of responsibilities are illustrated in Fig. 1), enabling them to optimize patient care, improve clinical outcomes, and manage healthcare costs effectively. The initial step is to establish an information management platform for standardized coding and cost analysis. Furthermore, this team provide comprehensive DRG training covering coding, cost management, medication use oversight, and clinical pathway management. In addition, pharmacists implement pre-prescription medication safety reviews. Evidence shows the

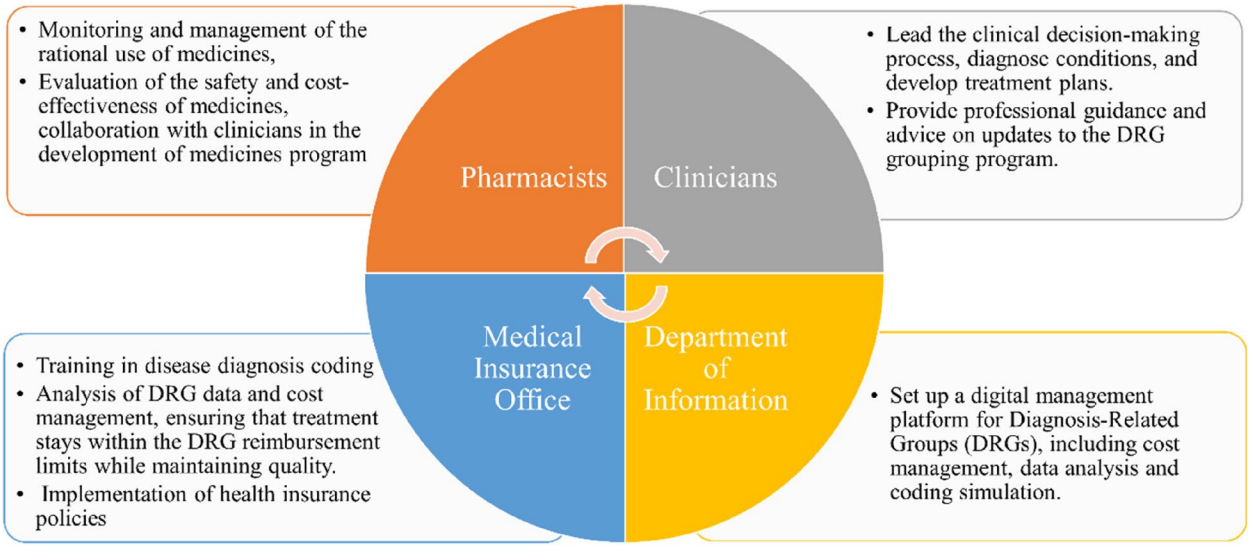

Fig. 1 Responsibilities in the DRG multidisciplinary management team

involvement of pharmacists in therapy can reduce unnecessary medication burdens and adverse events, indirectly decreasing the need for non-essential diagnoses [13]. Meanwhile, in obstetric care, pharmacists conduct specialized training for clinicals covering evidence-based formularies, fetal risk stratification and real-time therapeutic monitoring [14].This will help reduce discrepancies in direct drug use among various medical groups, improve the overall quality of medication management, and ensure that patients receive safe, effective, and cost-efficient drug use plans [15].

Evidence suggests that under the DRG payment reform, pharmacists contribute to hospitalization cost reduction through optimizing medication regimens [16]. Unlike traditional models where pharmacists review prescriptions retrospectively, this study shifts pharmacists from retrospective medication reviews to pre-prescription fetal risk assessment, aiming to reduce unnecessary medication discrepancies and lower readmission rates in pregnancy care. The Bavarian Drug Agreement requires pharmacists to assess the reasonableness of prescriptions and thereby control pharmaceutical expenditures through reduction of high-cost medication overuse [17]. However, current studies on multidisciplinary management under DRG payment system primarily focus on diseases with well-defined clinical pathways, such as chemotherapy and radiotherapy [18]. Pharmacist interventions can reduce medication waste among coronary heart disease inpatients, directly lowering the risk of DRG payment overruns [19].

EHR data in the U.S. healthcare system may lead to incomplete medication effectiveness evaluations [20, 21]. In this study, the platform integrates multi-source data, such as EHR and health insurance data, then performs real-time analysis, and issues alerts for irrational data, prompting multidisciplinary team members to intervene. In addition, Obstetric DRG payment systems should integrate clinical guidelines and real-world data to optimize resource allocation. The Italian Medicines Agency (AIFA) established a pregnancy drug monitoring network to oversee clinical medication use and ensure appropriate reimbursement of antihypertensive drugs [22].

This study addresses critical gaps in obstetric medication management under DRG payment reforms by establishing a new multidisciplinary model that transitions from retrospective medication review to prospective risk assessment for pregnant women. Specifically, examines how combining real-time therapeutic monitoring with risk alerts and DRG cost controls simultaneously reduces adverse drug reactions and improves classified management of high-risk pregnancies. Additionally, the findings offer support for the applicability of care management models and DRG payment policies to other special populations.

Methods

Setting

Zhejiang province began to implement DRG payment system reform in 2020, and all hospital inpatients and their expenses (bed fees above 40 Yuan are excluded) were in DRG payment system. The Women's Hospital School of Medicine Zhejiang University was selected as the example in this study. Although it is a single-center study, this hospital is the largest maternity hospital in Zhejiang Province, with 1, 520 open beds with an annual childbirth volume of more than 2, 1, 000 neonates and 82, 700 in-patients. Patients are relatively concentrated, which is representative.

Data sources

The obstetric patient data were collected from hospital information systems (HIS) and medical insurance databases between January 1, 2020 and December 31, 2024. The dataset included the following variables: patients' basic demography, diagnosis-related groups, diagnosis and operation code, and hospitalization expenditures list (drug expenditure, materials expenditure, total expenditure). This study initially included 131, 640 cases. Patients had to meet the following inclusion criteria to be eligible: (1) health insurance patients; (2) inpatients from the obstetric department; (3) complete data, especially the cost and details of drugs; (4) There are more than 30 cases in the DRG group. Exclusion list: (1) self-funded patients; (2) missing data cases. Finally, a total of 122, 516 cases were included.

Statistical analysis

In this study, we adapted the Boston Matrix framework by utilizing the Time Consumption Index as the horizontal axis and the Cost Consumption Index as the vertical axis (with 1 representing the origin) to classify and assess various disease groups, TCI represents bed-day efficiency, while CCI reflects cost-effectiveness relative to peer institutions. This visual framework effectively identifies high-resource-consuming DRG groups (lower-left quadrant) for targeted resource reallocation, directly supporting DRG reform objectives of simultaneous efficiency improvement and cost containment. The calculation formulas for the two indices are as follows:

$$\mathrm{TCI} = \sum \left(\frac{\text{The average length of stay for this disease group in the medical institution}}{\text{The average length of stay for this disease group in all healthcare institutions}} * \text{Total cases in this disease group in this hospital} \right) / \text{Total cases of all disease groups in this hospital}$$

$$\mathrm{CCI} = \sum \left(\frac{\text{The average hospitalization cost for this disease group in the medical institution}}{\text{The average hospitalization cost for the specific disease group across all medical institutions}} * \text{Total cases in this disease group in this hospital} \right) / \text{Total cases of all disease groups in this hospital}$$

Data analysis was carried out using SPSS 23. 0 (IBM, Armonk, NY, USA). Non - normally distributed continuous variables expressed as medians and interquartile ranges (IQR), while categorical data are expressed as frequencies and percentages. Spearman correlation analysis was employed to identify the key cost drivers by examining the relationships between detailed expense components and total hospitalization costs. The Kruskal-Wallis test assessed expenditure differences across years, controlling for policy-phase effects. For multivariate analysis, a generalized linear model (GLM) with gamma distribution and log-link function was selected due to right-skewed cost data. Compared to linear regression, GLM demonstrated superior performance in fitting non - normally distributed data and handled heteroscedasticity effectively. The model adjusted for confounder hospital resource allocation patterns. Importantly, COVID-19-related hospitalization costs were fully reimbursed through a dedicated government fund (non-DRG payment) during the study period. Moreover, there is no document indicating that there have been significant policy shifts in health insurance rules. Sensitivity analyses excluded outlier DRG. Statistical tests were two-sided with significance set at $P < 0.05$, with confidence intervals (CI) at the 95% level for all analyses.

Results

Outcomes and quality metrics of disease groups in obstetrics

From January 1, 2020 to December 31, 2024, a specialized hospital's obstetric department had a total of 131, 640 discharged cases, involving 103 DRG disease groups. Excluding the disease groups with fewer than 30 cases, a total of 122, 516 cases were included in 36 DRG disease groups (the definitions of these DRG groups, see abbreviations). Specific information is shown in Table 1 and the obstetric treatment groups are shown in Table 2. Subsequently, a Boston Matrix diagram was created with the Time Consumption Index (TCI) as the abscissa and the Cost Consumption Inde (CCI) as the vertical coordinate, with the origin (1, 1) serving as the reference point for comparison (Figs. 2 and 3).

According to Tables 1 and 2, the overall situation of the obstetric expenditure in 2020 and 2021 was in deficit, with 14 and 8 overspending diseases respectively, and 5 and 11 disease groups with a surplus respectively. In 2022, the overall situation of the obstetrics department was in surplus, with 7 overspending disease groups and 12 disease groups with a surplus. The Case-Mix Index (CMI), which reflects clinical complexity, improved from 0. 49 to 0. 52. Notably, there has been a significant increase in the proportion of Grade III and IV surgeries, while the average length of stay (ALOS) has shown a consistent downward trend. Furthermore, the 15-day readmission rate has been maintained at approximately 1%. DRG operations improved annually. By utilizing a sample of the top five disease groups by case volume as a case study, a decline from 9525. 56 Yuan (about $1,310) in 2020 to 8436.74 Yuan (about $1,160) in 2024 can be observed for the OB13 group. The average cost for the OZ13 group decreased by 304. 09 Yuan (about $42), while the OC13 group experienced the most significant reduction in average hospitalization costs, declining from 6491. 91 Yuan (about $893) to 3849.90 Yuan (about $529).

The Boston matrix graph was used to further analyze the obstetric DRG disease group. The Boston matrix graph was divided into four regions: TCI < 1 and CCI < 1, TCI > 1 and CCI < 1, TCI > 1 and CCI > 1, TCI < 1 and CCI > 1. TCI < 1 and CCI < 1 represents a zone with shorter length of stay (LOS) and DRG surplus, typically corresponding to technically mature day surgeries. TCI > 1 and CCI < 1 indicates a zone requiring optimization of clinical pathways to reduce LOS, suggesting inefficiencies in care delivery. TCI > 1 and CCI > 1 signifies a high-priority zone where both LOS and hospitalization costs require coordinated control, necessitating evaluation of

Table 1 The specific situation of the department of obstetrics

Year	Case	Average Cost of Hospital (Yuan)	Financial Balance/Overspend per Case (Yuan)	Average Length of Stay	Percentage of Grade III/IV Surgeries (%)	Case Mix Index	Time Consumption Index?	Cost Consumption Index	15-Day Readmission Rate (%)
2020	20, 060. 00	6, 937. 45	−49. 16	5. 65	12. 90	0. 49	1. 06	1. 00	0. 78
2021	21, 310. 00	7, 076. 02	−222. 38	5. 35	11. 61	0. 49	1. 06	0. 91	0. 67
2022	24, 177. 00	6, 381. 67	156. 76	4. 57	13. 46	0. 50	0. 83	0. 89	1. 71
2023	27, 677. 00	6, 330. 84	−6. 89	4. 37	15. 64	0. 52	0. 97	0. 92	1. 37
2024	29, 292. 00	6, 006. 83	30. 41	4. 16	15. 87	0. 52	0. 96	0. 91	1. 08
Total	122, 516. 00	6, 492. 34	−10. 08	4. 74	14. 33	0. 51	0. 90	0. 91	0. 98

Table 2 Obstetric admission group from 2020 to 2024

DRG Groups	2020			2021			2022			2023			2024		
	Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)
OB13	5, 435. 00	9, 525. 56	874. 49	5, 988. 00	9, 828. 82	−209. 00	6, 791. 00	9, 181. 79	118. 24	8, 103. 00	9, 314. 51	−635. 85	8, 365. 00	8, 436. 74	−215. 11
OC19	0. 00	0. 00	0. 00	5, 678. 00	8, 321. 80	−1, 113. 44	6, 452. 00	7, 506. 57	−171. 13	8, 220. 00	6, 478. 33	538. 09	9, 599. 00	6, 259. 89	354. 58
OZ13	1, 809. 00	2, 482. 18	−102. 04	2, 772. 00	2, 425. 30	−124. 38	4, 041. 00	2, 212. 40	−34. 11	4, 664. 00	2, 248. 44	−155. 79	3, 893. 00	2, 177. 49	−254. 45
OC13	7, 750. 00	6, 491. 91	−624. 30	2, 960. 00	4, 606. 66	1, 346. 63	2, 616. 00	4, 072. 82	1, 583. 50	1, 852. 00	3, 940. 10	1, 600. 36	1, 633. 00	3, 849. 90	1, 386. 75
OZ15	913. 00	1, 738. 73	316. 45	989. 00	1, 634. 19	293. 73	1, 093. 00	1, 489. 66	188. 13	1, 129. 00	1, 569. 69	−17. 82	1, 639. 00	1, 555. 81	−82. 54
OB11	528. 00	14, 526. 61	−1, 207. 46	599. 00	14, 020. 41	−1, 740. 82	808. 00	12, 609. 12	−567. 27	1, 261. 00	11, 861. 71	−1, 598. 53	1, 188. 00	11, 200. 99	−1, 451. 27
OB15	863. 00	8, 219. 21	1, 606. 21	624. 00	8, 365. 93	419. 29	422. 00	7, 819. 20	560. 75	413. 00	7, 996. 50	−106. 59	781. 00	7, 470. 57	87. 14
OF13	205. 00	5, 832. 88	−1, 271. 19	250. 00	4, 946. 32	−664. 47	315. 00	4, 046. 20	41. 30	341. 00	3, 666. 37	−81. 05	298. 00	3, 348. 24	−18. 24
OC11	542. 00	7, 939. 92	−852. 11	179. 00	6, 540. 71	706. 13	183. 00	5, 730. 28	1, 209. 12	172. 00	5, 189. 02	1, 429. 93	140. 00	5, 430. 13	783. 98
OD23	203. 00	6, 770. 02	−1, 326. 32	231. 00	6, 789. 77	−635. 93	236. 00	5, 919. 04	−498. 59	235. 00	5, 538. 64	−743. 89	285. 00	5, 659. 44	−1, 060. 08
OR13	632. 00	5, 350. 89	−194. 79	176. 00	3, 932. 20	1, 356. 49	119. 00	3, 467. 77	1, 455. 15	111. 00	3, 427. 42	2, 019. 87	96. 00	3, 725. 04	1, 448. 21
OZ11	95. 00	3, 535. 79	77. 04	124. 00	3, 297. 23	255. 31	179. 00	2, 587. 87	264. 18	216. 00	3, 451. 42	−35. 93	246. 00	2, 576. 35	−201. 79
OR19	0. 00	0. 00	0. 00	139. 00	7, 230. 68	−494. 32	139. 00	7, 310. 59	−416. 63	210. 00	5, 431. 61	1, 086. 14	244. 00	5, 343. 87	807. 50
OF15	133. 00	4, 995. 48	−1, 247. 79	93. 00	4, 272. 57	−739. 10	109. 00	3, 202. 65	202. 10	133. 00	3, 074. 53	167. 96	174. 00	2, 887. 00	278. 29
OS23	177. 00	3, 436. 87	−156. 61	33. 00	3, 844. 83	−309. 82	74. 00	3, 642. 37	−435. 05	82. 00	3, 388. 74	−709. 29	99. 00	3, 516. 35	−936. 29
OC15	263. 00	6, 604. 41	−979. 52	36. 00	4, 245. 33	1, 654. 42	31. 00	3, 434. 21	1, 859. 90	20. 00	3, 674. 98	1, 626. 39	42. 00	3, 525. 29	1, 525. 77
OS13	37. 00	2, 757. 44	−9. 43	75. 00	2, 430. 78	124. 51	112. 00	2, 599. 40	−121. 03	52. 00	2, 286. 27	31. 67	46. 00	1, 848. 57	154. 25
OF11	44. 00	9, 401. 40	−1, 889. 00	50. 00	8, 482. 98	−990. 83	60. 00	6, 805. 18	−664. 11	77. 00	5, 535. 99	−42. 89	74. 00	6, 184. 38	−1, 150. 67
OJ13	24. 00	6, 921. 78	−2, 431. 01	29. 00	6, 292. 01	−1, 814. 55	79. 00	4, 063. 51	−463. 63	78. 00	3, 216. 51	238. 48	89. 00	2, 941. 65	−161. 70
OD25	29. 00	3, 789. 06	315. 40	37. 00	4, 229. 75	−286. 65	35. 00	2, 217. 13	197. 26	36. 00	2, 811. 28	201. 46	63. 00	2, 348. 55	23. 37
OS15	20. 00	1, 600. 57	357. 05	43. 00	1, 732. 48	155. 74	43. 00	1, 848. 79	112. 14	34. 00	1, 625. 29	97. 96	59. 00	1, 657. 80	−47. 38
OR15	126. 00	5, 010. 43	−182. 94	17. 00	3, 108. 13	1, 551. 28	8. 00	2, 977. 32	2, 329. 45	8. 00	2, 927. 04	2, 276. 46	9. 00	3, 488. 38	1, 950. 44
OF23	21. 00	5, 035. 12	−1, 456. 42	33. 00	4, 728. 67	−1, 712. 45	32. 00	3, 141. 47	−552. 07	32. 00	3, 540. 63	−1, 008. 17	35. 00	3, 286. 52	−863. 73
OS25	52. 00	2, 904. 54	−533. 52	7. 00	1, 737. 99	111. 43	11. 00	3, 650. 79	−1, 289. 77	22. 00	2, 337. 13	−472. 74	36. 00	2, 448. 34	−752. 47
OJ15	13. 00	3, 241. 73	−13. 83	13. 00	3, 509. 88	−339. 19	26. 00	2, 182. 35	−61. 08	25. 00	1, 954. 74	554. 40	35. 00	1, 691. 42	299. 91
OR11	74. 00	5, 698. 28	1, 258. 06	9. 00	4, 770. 76	1, 196. 21	11. 00	5, 414. 98	244. 21	7. 00	4, 344. 47	2, 559. 67	9. 00	7, 605. 84	−1, 144. 45
XT39	11. 00	1, 996. 30	−78. 10	18. 00	2, 001. 15	379. 95	28. 00	1, 855. 13	800. 76	31. 00	2, 061. 08	836. 06	21. 00	1, 862. 00	578. 03
OD13	6. 00	10, 360. 70	−1, 549. 55	31. 00	8, 857. 47	−856. 59	18. 00	9, 588. 93	−2, 272. 01	8. 00	11, 045. 53	−4, 168. 19	13. 00	11, 418. 66	−3, 698. 01
OD21	8. 00	11, 049. 73	−3, 635. 61	15. 00	9, 146. 38	−2, 398. 82	14. 00	10, 892. 63	−3, 565. 47	22. 00	6, 800. 61	−1, 392. 01	15. 00	14, 031. 15	−6, 403. 72
OF21	8. 00	9, 701. 21	−4, 220. 01	9. 00	3, 130. 41	700. 40	21. 00	3, 850. 53	−293. 82	19. 00	5, 130. 00	−1, 508. 40	11. 00	6, 552. 72	−2, 401. 69
OS21	19. 00	4, 411. 67	−738. 31	3. 00	5, 834. 86	−1, 641. 86	13. 00	4, 755. 22	−1, 042. 38	15. 00	7, 364. 96	−2, 901. 01	13. 00	5, 815. 90	−2, 201. 36
OS11	5. 00	2, 891. 95	1, 477. 63	12. 00	6, 105. 55	−2, 362. 06	16. 00	2, 596. 73	421. 32	12. 00	2, 296. 91	−184. 81	11. 00	5, 776. 03	−1, 239. 11

Table 2 (continued)

DRG Groups	2020 Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	2021 Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	2022 Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	2023 Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)	2024 Case	Average Hospital Cost (Yuan)	Case Balance/ Overspend (Yuan)
OF25	8.00	2, 674.40	397.06	14.00	3, 320.19	−970.88	8.00	2, 749.05	−679.82	9.00	2, 874.48	−766.43	16.00	2, 371.33	−436.16
OD11	5.00	15, 208.52	−2, 087.77	10.00	24, 536.52	−8, 168.56	10.00	16, 496.67	−5, 716.85	12.00	25, 551.40	−7, 876.11	6.00	9, 369.73	−1, 814.46
NC13	1.00	7, 654.11	8, 718.21	3.00	13, 154.09	2, 019.88	14.00	11, 169.52	3, 110.61	11.00	8, 601.66	6, 029.44	6.00	7, 454.70	6, 890.95
OJ11	1.00	10, 664.67	−2, 735.82	11.00	9, 448.75	−1, 814.64	10.00	9, 271.67	−3, 304.39	5.00	3, 892.05	1, 826.26	3.00	3, 210.65	1, 974.43
Total	20, 060.00	6, 937.45	−49.16	21, 310.00	7, 076.02	−222.38	24, 177.00	6, 381.67	156.76	27, 677.00	6, 330.84	−6.89	29, 292.00	6, 006.83	30.41

the developmental prospects of the clinical discipline for disease groups in this category. TCI < 1 and CCI > 1 highlights a cost-containment zone where fee control strategies must be implemented, accompanied by analysis to identify underlying causes of cost inefficiencies.

As shown in Figs. 2 and 3 and a total of 22 disease groups had both time consumption index and cost consumption index values below 1. Among these, seven disease groups transitioned from the third quadrant to the first quadrant, including OC13 (vaginal delivery with surgical procedure, with general co morbidity or complications), OB13 (cesarean section with general comorbidity or complications), and OF15 (midterm labor induction procedure without comorbidities or complications), among others. This reflects improved standardization of clinical pathways. For the OD 23 (vulval, vaginal, and cervical surgery related to pregnancy, with general complications and comorbidities) disease group, the cost consumption index increased; however, the average hospitalization cost decreased from 6770. 02 (about $931) Yuan to 5659. 44 Yuan (about $779). Additionally, the OB11 (cesarean section with severe complications or comorbidities) disease group shifted from the first quadrant to the fourth quadrant (indicating an increase in the time consumption index), while the average length of hospital stay decreased from 9.02 days to 6. 20 days. Among them, the OZ13 (other pregnancy-related disorders, with general complications and comorbidities) disease group was taken as an example for the subsequent cost structure analysis because of its average cost per hospitalization decreased, while the cost consumption index increased.

Basic information on the patients in the OZ 13 disease group

A total of 17, 179 cases of the OZ 13 disease group were included in this study, with their disease information and hospitalization costs shown in Table 3. The older the patients admitted to this disease group are, the higher the medical costs. Among them, there were 6, 427 cases (36. 52%) under the age of 30 (excluding), 1, 0167 cases (61. 80%) between the ages of 30 to 40 and only 288 cases (1. 68%) over the age of 40 (excluding). Besides, only 81. 95% of the cases had a hospital stay of less than or equal to 5 days, 16. 37% of the cases had hospitalization days between 6 and 15 days, and only 0. 42% of the cases had a hospital stay of more than 15 days. However, the hospitalization cost of these cases was much higher than that of the cases that stayed for less than or equal to 5 days. These diseases group haves 333 kinds of diagnosis which 180 kinds of diagnosis appeared less than 5 times were assigned to other diagnoses. According to disease coding rules, the similar codes are classified. The top five primary diagnoses are threatened preterm labor without

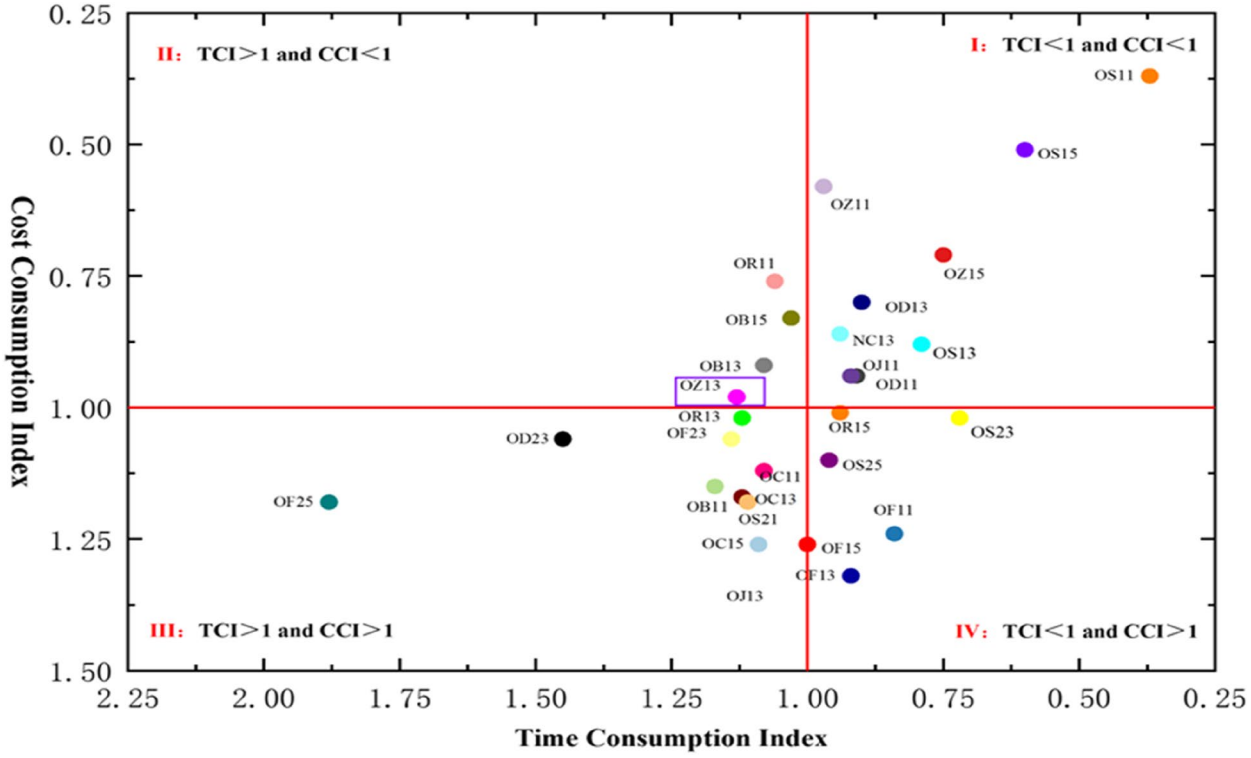

Fig. 2 Boston matrix chart of the time consumption index and cost consumption index for each obstetric disease group in 2020

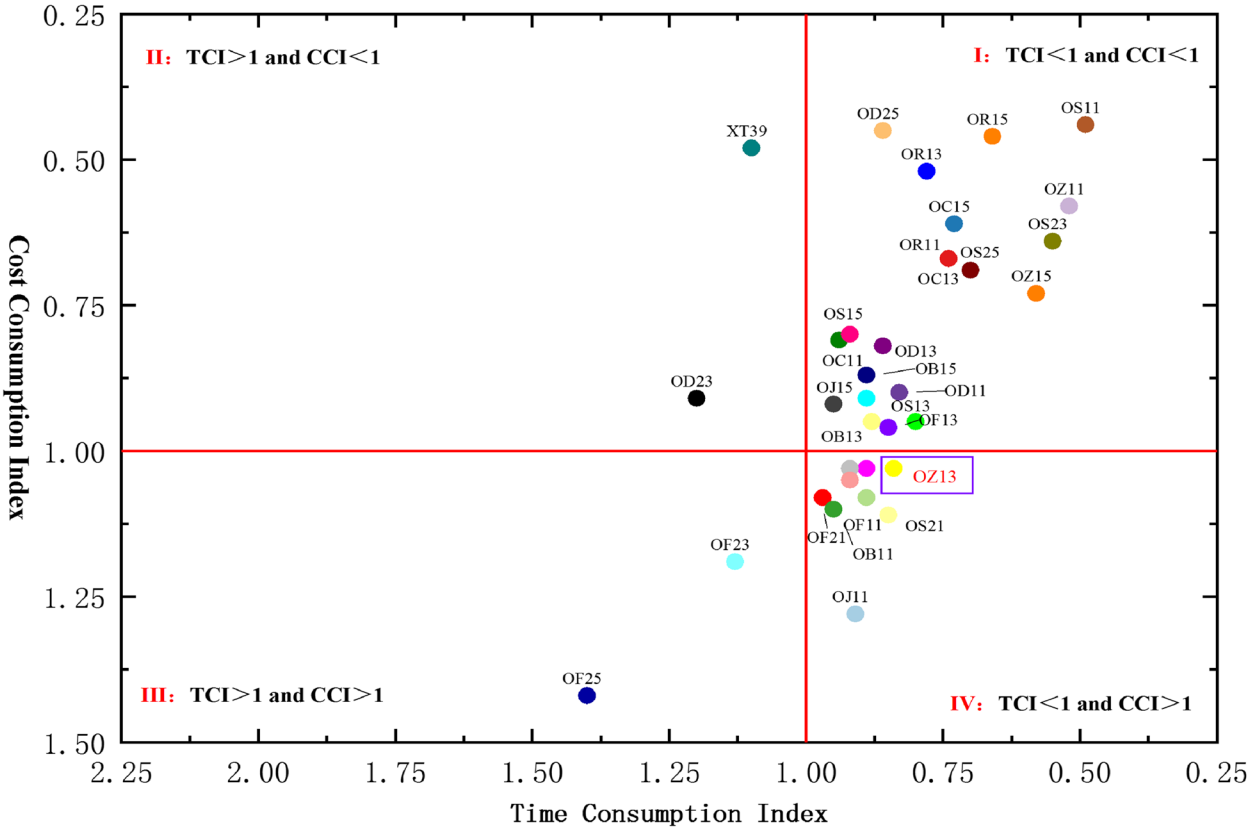

Fig. 3 Boston matrix chart of the time consumption index and cost consumption index for each obstetric disease group in 2024

Table 3 Basic information on patients and hospitalization costs

Variable	Case	Rat (%)	Median hospitalization cos (Yuan)	Median drug cost (Yuan)
Age (year)				
< 30	6, 274. 00	36. 52	2, 288. 73 (1, 226. 00, 2, 578. 00)	531. 62 (29. 00, 587. 00)
30–40	10, 617. 00	61. 80	2, 267. 29 (1, 226. 00, 2, 540. 00)	512. 89 (25. 00, 580. 00)
> 40	288. 00	1. 68	2, 381. 70 (1, 362. 00, 2, 702. 50)	518. 13 (44. 50, 620. 50)
Day of hospitalization (day)				
≤ 5	14, 078. 00	81. 95	1, 682. 36 (1, 146. 00, 2, 022. 00)	257. 36 (12. 00, 371. 00)
6–15	2, 812. 00	16. 37	4, 210. 23 (2, 909. 50, 4, 920. 00)	1, 319. 07 (617. 00, 1, 595. 50)
16–30	221. 00	1. 29	10, 530. 41 (6, 418. 00, 10, 893. 00)	5, 002. 14 (1, 502. 00, 4, 458. 00)
31–45	42. 00	0. 24	15, 045. 14 (11, 630. 00, 17, 527. 00)	5, 701. 14 (3, 078. 00, 6, 648. 00)
46–60	12. 00	0. 07	22, 135. 17 (14, 942. 50, 24, 010. 50)	10, 152. 00 (3, 799. 50, 10, 228. 00)
≥ 61	14. 00	0. 08	26, 363. 21 (19, 693. 00, 30, 553. 00)	9, 351. 00 (6, 261. 00, 11, 475. 00)
Primary diagnostic encoding				
Preterm labour not accompanied by delivery	4, 221. 00	24. 57	1, 729. 00 (1, 294. 00, 2, 422. 00)	210. 00 (53. 00, 508. 00)
Maternal treatment for fetal hypoxia	1, 219. 00	7. 10	1, 180. 00 (915. 00, 1, 553. 00)	9. 00 (0. 00, 61. 00)
Disorders of amniotic fluid and membranes	1, 003. 00	5. 84	1, 852. 00 (1, 376. 00, 2, 733. 00)	182. 00 (55. 00, 596. 00)
Medical Care for Pregnant Women with Poor Fetal Growth	931. 00	5. 42	3, 529. 00 (2, 682. 00, 4, 483. 00)	972. 00 (698. 00, 1, 399. 00)
Pregnancy supervision	901. 00	5. 24	1, 688. 00 (1, 204. 00, 2, 266. 00)	258. 00 (53. 00, 516. 00)
Maternal care for pelvic abnormalities	849. 00	4. 94	1, 810. 00 (1, 267. 00, 2, 610. 00)	293. 00 (61. 00, 650. 00)
Liver disorders in pregnancy	755. 00	4. 39	2, 620. 00 (1, 798. 00, 4, 005. 00)	826. 00 (390. 00, 1, 630. 00)
Gestational diabetes mellitus	722. 00	4. 20	1, 378. 00 (1, 052. 00, 1, 890. 00)	60. 00 (0. 00, 247. 00)
Threatened labor	482. 00	2. 81	1, 372. 50 (1, 039. 00, 2, 073. 00)	37. 00 (0. 00, 289. 00)
Mat care for (suspected) fetal abnormality	476. 00	2. 77	1, 472. 50 (1, 088. 50, 2, 040. 50)	69. 00 (0. 00, 347. 00)
Maternal care for malpresentation of fetus	463. 00	2. 70	1, 458. 00 (1, 199. 00, 1, 757. 00)	62. 00 (33. 00, 66. 00)
Placenta previa	412. 00	2. 40	2, 079. 50 (1, 409. 50, 2, 793. 00)	449. 50 (209. 50, 821. 50)
Ultrasound abnormalities in prenatal screening	394. 00	2. 29	1, 712. 00 (1, 268. 00, 2, 603. 00)	159. 50 (30. 00, 469. 00)
Maternal treatment for other fetal problems	378. 00	2. 20	1, 180. 50 (952. 00, 1, 528. 00)	1. 00 (0. 00, 40. 00)
Maternal infectious diseases	371. 00	2. 16	1, 834. 00 (1, 387. 00, 2, 351. 00)	320. 00 (114. 00, 568. 00)
Hemorrhage before 20 weeks gestation	335. 00	1. 95	1, 935. 00 (1, 534. 00, 2, 723. 00)	400. 00 (248. 00, 717. 00)
Gestational hypertension NOS	313. 00	1. 82	1, 660. 00 (1, 338. 00, 2, 222. 00)	69. 00 (1. 00, 174. 00)
Other abnormalities in antenatal screening	301. 00	1. 75	1, 271. 00 (1, 018. 00, 1, 672. 00)	14. 00 (0. 00, 136. 00)
Endocrine/metabolic diseases	260. 00	1. 51	1, 309. 50 (1, 022. 50, 1, 759. 00)	25. 00 (0. 00, 231. 00)
Complications specific to multiple gestation	256. 00	1. 49	2, 050. 00 (1, 547. 50, 2, 698. 50)	395. 50 (168. 00, 669. 50)
Other diseases complicating pregnancy	252. 00	1. 47	1, 548. 00 (1, 141. 00, 2, 164. 00)	169. 00 (9. 00, 456. 00)
Blood/immune disorders complicating pregnancy	242. 00	1. 41	1, 578. 50 (1, 169. 00, 2, 273. 00)	202. 50 (9. 00, 597. 00)
Anaemia complicating pregnancy	239. 00	1. 39	1, 674. 00 (1, 157. 00, 2, 348. 00)	259. 00 (37. 00, 539. 00)
Excessive vomiting in pregnancy	216. 00	1. 26	1, 837. 00 (1, 341. 50, 2, 701. 00)	465. 00 (211. 00, 903. 50)
Infections of genitourinary tract	171. 00	1. 00	2, 728. 00 (1, 790. 00, 4, 379. 00)	673. 00 (351. 00, 1, 359. 00)
Pre-eclampsia	162. 00	0. 94	2, 550. 00 (1, 800. 00, 4, 088. 00)	287. 50 (115. 00, 715. 00)
Respiratory system diseases	132. 00	0. 77	1, 860. 50 (1, 311. 00, 2, 347. 00)	226. 00 (106. 50, 386. 50)

Table 3 (continued)

Variable	Case	Rat (%)	Median hospitalization cos (Yuan)	Median drug cost (Yuan)
Placental disorders	85.00	0.49	1, 779. 00 (1, 223. 00, 2, 524. 00)	65. 00 (0. 00, 370. 00)
Pre-existing hypertension with pre-eclampsia	70.00	0.41	2, 426. 00 (1, 731. 00, 3, 904. 00)	316. 50 (116. 00, 934. 00)
Encounter for normal pregnancy	68.00	0.40	1, 665. 50 (1, 396. 00, 2, 324. 00)	316. 50 (169. 00, 481. 00)
Premature rupture of membranes	67.00	0.39	4, 514. 00 (2, 724. 00, 8, 679. 00)	1, 019. 00 (441. 00, 2, 938. 00)
Labor with umbilical cord complications	60.00	0.35	1, 241. 00 (937. 00, 1, 639. 00)	36. 50 (3. 00, 121. 00)
Preterm labour without delivery	58.00	0.34	1, 079. 00 (904. 00, 1, 357. 00)	0. 00 (0. 00, 56. 00)
Complications specific to multiple gestation	51.00	0.30	2, 172. 00 (1, 651. 00, 3, 609. 00)	206. 00 (84. 00, 712. 00)
Polyhydramnios	47.00	0.27	1, 369. 00 (1, 186. 00, 1, 946. 00)	14. 00 (0. 00, 96. 00)
Supervision of pregnancy with grand multiparity	47.00	0.27	1, 638. 00 (1, 123. 00, 2, 305. 00)	300. 00 (14. 00, 570. 00)
Premature separation of placenta	41.00	0.24	4, 147. 00 (2, 544. 00, 5, 276. 00)	887. 00 (347. 00, 1, 831. 00)
Third-stage haemorrhage	28.00	0.16	1, 787. 00 (1, 384. 00, 2, 506. 50)	407. 00 (276. 00, 720. 50)
Gestational proteinuria	20.00	0.12	1, 730. 00 (1, 389. 00, 2, 247. 00)	0. 00 (0. 00, 111. 00)
Others (diagnosis less than 5 times)	81.00	0.47	5, 966. 50 (1, 554. 00, 6, 900. 00)	617. 00 (14. 00, 1, 127. 00)

delivery (24. 57%), maternal medical treatment for signs of fetal hypoxia (7. 10%), disorders of amniotic fluid and fetal membranes (5. 84%), medical care for pregnant women with poor fetal growth (5. 42%), and Pregnancy supervision (5. 24%). Among the primary diagnoses with cases accounting for more than 5%, the hospitalization costs for threatened preterm birth and fetal growth retardation were higher than those for other primary diagnoses (Table 3).

Hospitalization costs in the OZ 13 disease group

The mean hospitalization cost in the OZ 13 group was2,282.82 Yuan (about $314). The hospitalization expenditures were categorized into the following components: Pharmaceutical costs (22. 76%), which mainly refer to drugs listed in the National Essential Medicines Directory. Medical consumables include sterile gauze, syringes, and implantable devices. Diagnostic test fees (17. 04%) include equipment - based examinations like MRI and ultrasound. Lab test fees (32. 52%) comprise routine tests, biochemical panels, and secretion analyses. Professional service fees including physician consultations and nursing care. Cost structure analysis revealed lab test fees (32. 52%), pharmaceutical costs (22. 76%) and diagnostic fees (17. 04%) as the three largest expenditure components. Spearman analysis indicated significant positive correlations between cost drivers and total hospitalization costs (all $P < 0.05$), with pharmaceutical expenditures showing the strongest association ($\rho = 0.81$, $P < 0.001$) (Table 4).

In light of the analysis results, Kruskal - Wallis H analysis was conducted into the hospitalization costs for this disease group. As demonstrated in Figs. 4 and 5, there was an annual decline in the average hospitalization cost and average pharmaceutical cost from 2020 to 2024. Moreover, compared with 2020, hospitalization costs in 2022 and 2024 showed statistically significant differences for this disease group, while the average pharmaceutical cost also differed significantly between 2020 and 2024 ($P < 0.05$). This finding suggests that multidisciplinary collaboration involving pharmacists serves as an effective strategy for managing pharmaceutical costs even hospitalization costs.

The medications were categorized according to the Anatomical Therapeutic Chemical (ATC) classification system (Table 5). The drugs in this disease group were primarily categorized into three classes: Genito urinary system and sex hormones, Alimentary tract and metabolism and Blood and blood forming organs. The highest expenditure category is sex hormone medications, including progestogens and tocolytic agents, which used to inhibit uterine contractions and prolong gestational age. Atosiban had the highest cost per treatment episod (5,071.68 Yuan, about $697). The cost of a treatment

Table 4 Hospitalization costs and correlation in the OZ13 disease group

Expense Classification	Average (Yuan)	Median (Yuan)	Rate (%)	Correlation with hospitalization costs
pharmaceutical cost	519. 57	205. 36	22. 76	0. 81**
Medical consumables cost	89. 38	68. 19	3. 92	0. 74**
Diagnostic test fee	389. 03	299. 00	17. 04	0. 50**
Lab test fee	742. 45	649. 00	32. 52	0. 64**
Nursing fee	165. 60	119. 60	7. 25	0. 79**
Physician's treatment fee	240. 21	178. 40	10. 52	0. 78**
Others	136. 59	90. 00	5. 98	0. 77**
Total	2282. 82	1715. 92	100. 00	

**means $P < 0.05$

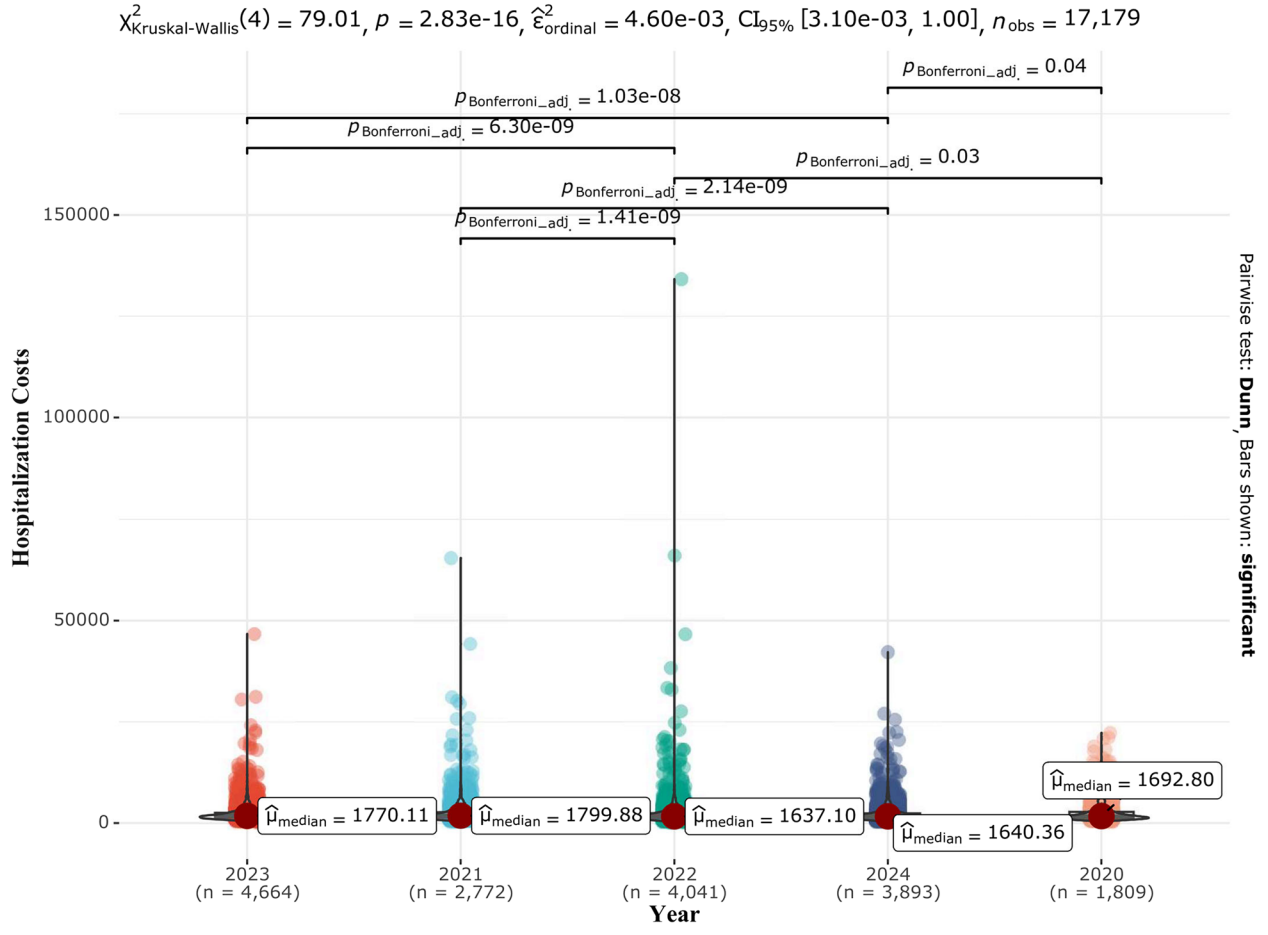

Fig. 4 Intergroup comparison of hospitalization costs for the OZ13 disease group from 2020 to 2024

course is11,500 Yuan (about $1,582), with only 2,300 Yuan (about $316) reimbursable under OZ13 disease group, necessitating careful clinical consideration when prescribing.

Subsequently, an analysis was conducted of the costs among different medical groups in 2020 and 2024. As there were 24 medical groups in 2020 and 22 in 2024, Table 6 compares the 12 medical groups for which data were available in both years. With the exception of Group 1, 2 and 12, a decline in the average hospitalization costs was observed for all other groups. A closer analysis reveals that only five groups demonstrated a decline in average pharmaceutical costs, with Group 7 exhibiting the most substantial decrease. Concerning the average length of stay, all groups except Group 12 have shown a reduction, with Group 2 experiencing the most significant decrease of 3. 66 days. In light of Group 12 demonstrating an increase in the average costs of hospitalization, pharmaceuticals, and length of stay, further analysis indicated that patients treated in this group were on average older than those treated in other groups.

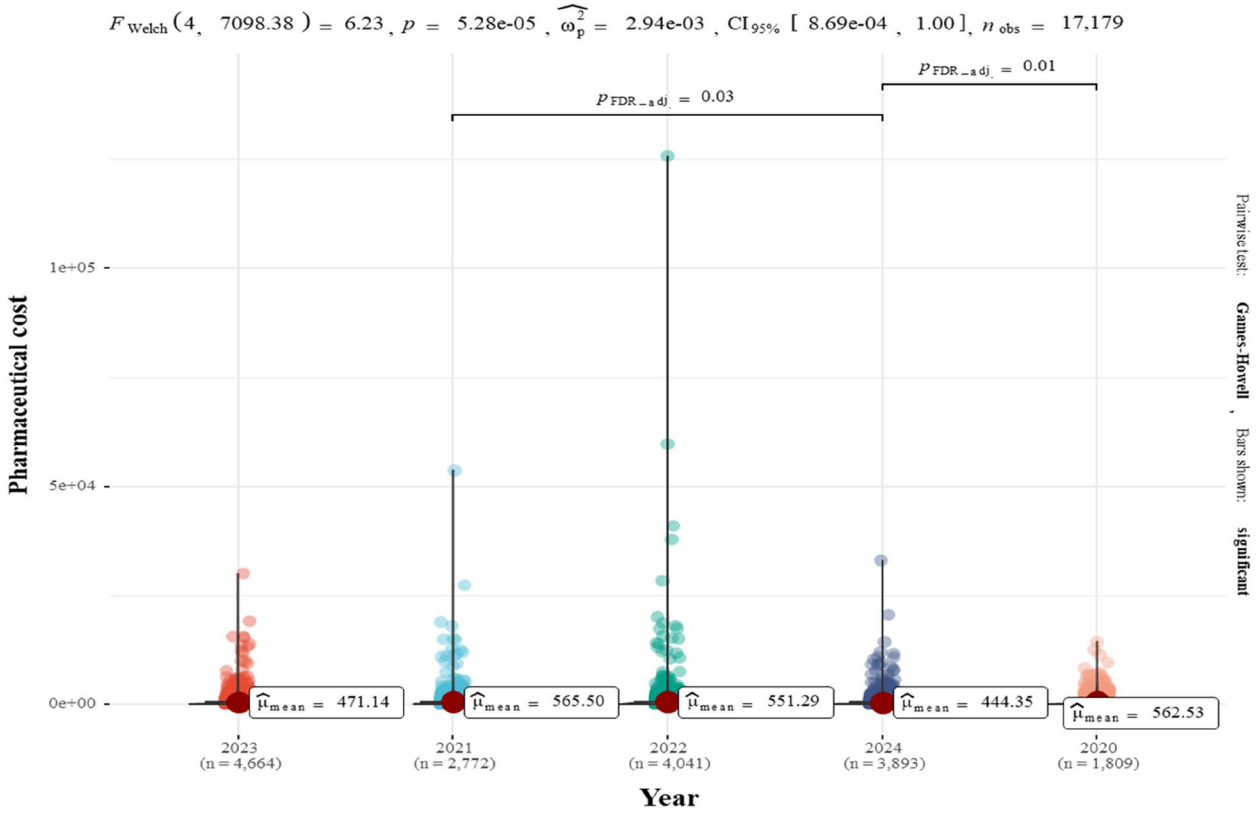

Fig. 5 Intergroup comparison of pharmaceutical expenditures for the OZ13 Disease Group from 2020 to 2024

Table 5 Medication classification in the OZ 13 disease group in 2024

Therapeutic Category	Drug Generic Name	Total Amount (Yuan)	Case Count	Avg. Cost/Case (Yuan)
Genito urinary system and sex hormones		1, 045, 380. 66	5, 170. 00	202. 20
Progestogens	Dydrogesterone	178, 061. 16	1, 700. 00	104. 74
	Progesterone	33, 671. 48	738. 00	45. 63
Tocolytic agents	Atosiban	410, 806. 04	81. 00	5, 071. 68
	Ritodrine	195, 564. 94	1, 472. 00	132. 86
	Magnesium sulfate	65, 433. 36	2, 206. 00	29. 66
	Phloroglucinol	55, 553. 43	520. 00	106. 83
Alimentary tract and metabolism		101, 052. 43	1, 504	67. 19
Iron preparations	Iron polysaccharide complex	32, 339. 02	609. 00	53. 10
	Iron proteinsuccinylate	19, 964. 08	121. 00	164. 99
Laxatives	Lactulose	15, 933. 88	365. 00	43. 65
	Wheat fiber	23, 499. 42	217. 00	108. 29
Probiotics	Clostridium butyricum	8, 315. 03	192. 00	43. 31
Blood and blood forming organs		183, 427. 62	1, 417	129. 43
Anticoagulants	Nadroparin calcium	27, 498. 18	356. 00	77. 24
	Fondaparinux sodium	36, 512. 56	219. 00	166. 72
	Enoxaparin sodium	23, 023. 28	246. 00	93. 59
Blood products	human albumin	20, 374. 00	21. 00	970. 19
	Human normal immunoglobulin	61, 149. 00	5. 00	12, 229. 80
Immunostimulants	Recombinant human granulocyte colony-stimulating factor	11, 823. 84	14. 00	844. 56

Table 6 Comparative analysis across different groups in the OZ13 disease group between 2020 and 2024

Medical Group	2020				2024			
	Cases	Average Hospitalization Cost (Yuan)	Average Pharmaceutical Cost (Yuan)	Average Length Of Stay (Days)	Cases	Average Hospitalization Cost (Yuan)	Average Pharmaceutical Cost (Yuan)	Average Length Of Stay (Days)
Group 1	158. 00	2, 238. 40	408. 51	5. 25	246. 00	2, 498. 61	523. 29	3. 63
Group 2	118. 00	2, 172. 77	438. 65	5. 32	18. 00	2, 519. 29	235. 67	1. 67
Group 3	112. 00	2, 766. 58	743. 12	5. 03	244. 00	2, 121. 56	404. 23	3. 40
Group 4	20. 00	1, 750. 36	271. 57	3. 30	76. 00	1, 593. 49	308. 28	3. 07
Group 5	66. 00	2, 109. 91	438. 09	4. 47	78. 00	2, 036. 31	554. 78	2. 79
Group 6	96. 00	2, 946. 17	750. 73	4. 76	290. 00	2, 879. 68	676. 82	4. 23
Group 7	97. 00	3, 458. 66	1, 184. 98	5. 01	232. 00	1, 945. 47	270. 04	3. 50
Group 8	115. 00	1, 936. 05	324. 62	3. 28	145. 00	1, 904. 19	348. 67	2. 54
Group 9	43. 00	2, 758. 50	533. 11	5. 51	143. 00	2, 400. 97	576. 37	3. 25
Group 10	106. 00	2, 268. 67	480. 35	4. 82	298. 00	2, 231. 51	401. 26	3. 79
Group 11	95. 00	2, 518. 44	551. 35	5. 07	85. 00	2, 217. 89	733. 25	3. 81
Group 12	12. 00	2, 084. 86	251. 26	3. 67	225. 00	2, 862. 39	597. 56	5. 60

Table 7 Results of the generalized linear regression model

Variable	Category	β	SE	Wald	*P*-value	95% CI
Intercept		10. 723	0. 444	583. 651	< 0. 001	9. 853, 11. 593
History of Habitual Abortion or IVF Status	No	−0. 058	0. 010	36. 952	< 0. 001	−0. 077, −0. 039
	Yes	-	-	-	-	-
Gestational Weeks	< 12	0. 080	0. 037	4. 659	0. 031	0. 007, 0. 153
	12–27	0. 103	0. 008	172. 259	< 0. 001	0. 087, 0. 118
	≥ 28	-	-	-	-	-
Parity	1	−0. 473	0. 428	1. 220	0. 269	−1. 312, 0. 366
	2	−0. 490	0. 428	1. 312	0. 252	−1. 330, 0. 349
	3	−0. 463	0. 429	1. 165	0. 280	−1. 303, 0. 377
	4	−0. 414	0. 434	0. 910	0. 340	−1. 265, 0. 437
	5	−0. 462	0. 479	0. 933	0. 334	−1. 400, 0. 476
	6	-	-	-	-	-
Age	< 30	−0. 033	0. 026	1. 584	0. 208	−0. 084, 0. 018
	30–40	−0. 041	0. 026	2. 508	0. 113	−0. 091, 0. 010
	> 40	-	-	-	-	-
Length Of Stay (days)	≤ 5	−2. 755	0. 115	579. 117	< 0. 001	−2. 979, −2. 530
	6–15	−1. 847	0. 115	259. 232	< 0. 001	−2. 072, −1. 622
	16–30	−0. 924	0. 118	61. 362	< 0. 001	−1. 155, −0. 693
	31–45	−0. 561	0. 132	18. 006	< 0. 001	−0. 819, −0. 302
	46–60	−0. 176	0. 168	1. 096	0. 295	−0. 506, 0. 154
	≥ 61	-	-	-	-	-

Factors influencing hospitalization costs in the OZ13 disease group

This study developed a generalized linear model with gamma distribution and log-link function, incorporating the following independent variables: history of habitual abortion or in vitro fertilization (IVF) status, gestational weeks, parity, age, and length of hospital stay. The primary dependent variable was hospitalization costs. The model demonstrated adequate goodness-of-fit (χ^2 = 14819. 36, P< 0. 01). The Type I and Type III model effect tests indicated that the patient's history of habitual abortion or IVF status, gestational weeks, parity, age, and length of hospital stay were factors influencing the hospitalization costs of the OZ13 group. Compared to the reference group (gestational weeks ≥ 28), patients in early pregnancy (< 12 weeks) exhibited an 8. 3% increase in hospitalization costs (P= 0. 031). The cost was more pronounced in mid-pregnancy (12–27 weeks) with a 10. 8% increase (P< 0. 001). For more detailed data, refer to Table 7.

Discussion

This study analyzed data from the obstetrics department between 2020 and 2024 in order to explore the impact of DRG reform on the quality and efficiency of obstetric medical services.

Our study observed a reduction in ALOS from 5.65 to 4.16 days, consistent with findings from prior research. Notably, the TCI in our analysis showed initially declined before rebounding, reaching its lowest value (0.83) in 2022. This aligns with Anhui Province's DRG reform [23]. Moreover, the proportion of Grade III and IV surgeries increased from 12.90 to 15.87%, indicating an enhancement in the medical capacity to treat complex obstetric diseases. Additionally, despite an observed rise in 15-day readmission rates within the obstetrics department (particularly reaching 1.71% in 2022), the available evidence remains inconclusive regarding the impact of DRG reform on readmission rates [24, 25]. Most studies confirm that DRG payment improves healthcare efficiency and capabilities of medical services [26, 27], though the magnitude of improvement varies across regions, likely due to differences in baseline efficiency and local policy adaptations [28, 29]. Future research should conduct multi-regional comparisons to identify best practices.

This study demonstrates a consistent annual reduction in average medical expenses, particularly in pharmaceutical costs, within the obstetrics department. The declining trend in the Cost Consumption Index (CCI) suggests that the DRG payment system effectively controlled hospitalization costs through economic incentives and budget constraints, while optimizing resource utilization efficiency [30]. In the meantime, the average hospitalization expenses for the OZ13 disease group decreased from 2,482.18Yuan (about $342) to 2177.49 Yuan (about $300). This group falls under internal medicine, which typically employs pharmacological treatments for disease management. Research indicates the participation of clinical pharmacists in DRG management can significantly decrease the medical burden on patients, including reductions in average hospitalization duration, average hospitalization costs, mortality rates, and readmission rates [31, 32]. What's more, pharmacists can develop clinical guidelines for DRG to promote standardized drug use. This approach is beneficial for optimizing the use of medical resources and delivering effective healthcare services [33, 34].

While DRG reform has improved healthcare efficiency and reduced costs, the study also identified aspects requiring refinement in DRG application. The results of this study indicate that there is a significant difference among the various medical groups in the OZ 13 disease category. The primary factors contributing to this disparity are the selection, dosage, and combination of drugs used for the treatment or prevention of preterm labor [35]. Both atosiban and ritodrine are tocolytic agents for treating threatened preterm labor, but their substantial price difference results in significantly lower utilization of atosiban compared to ritodrine. Even though clinical pharmacists consistently analyze and enhance the medication plans to address DRG cost overruns and directly manage unreasonable drug costs, the outcomes vary significantly among different medical groups. This discrepancy may be attributed to inadequate clinical pathway management, as clinicians have not effectively streamlined the diagnosis and treatment protocols [36]. Strengthening multidisciplinary group discussions and clinical pathway management aims to provide professional technical support for the rationalization and standardization of clinical practices, ensuring the quality of healthcare and improving the rationality of treatment [37].

Although the sample hospital has made efforts to control medical costs, the OZ 13 disease group has been experiencing overspending. The results of the Generalized Linear Model (GLM) revealed that recurrent miscarriage or in vitro fertilization (IVF) pregnancy status significantly influenced medical expenditures ($P< 0.05$). Additionally, as Zhejiang Province's critical maternal care center, the hospital annually manages over 80% of the province's severe obstetric emergencies. The current DRG payment system is uniformly applied to all inpatients without differentiating based on patient characteristics or disease severity. These findings underscore the need for risk-adjusted reimbursement models, such as higher payments for high-complexity obstetric cases, to ensure equitable resource allocation [38]. Specifically, the DRG payment system should differentiate between less complex and more complex cases, enabling hospitals and obstetricians managing a higher proportion of severe conditions to receive appropriately increased reimbursement rates [39].

In this study, the hospitalization expenses for stays of 6 to 15 days are approximately 2,500 Yuan (about $344) higher than those for stays of less than 5 days, and the drug costs are about 1,000 Yuan (about $138) higher. Besides, the length of stay has been demonstrated to be a significant factor in determining the inpatient medical expenses of OZ13 disease group. Pregnant women who remain in the hospital for extended periods cannot reduce medical expenses solely by conserving medical resources. In Zhejiang Province, hospitals can apply for per-diem payments if the length of stay (LOS) exceeds 61 days, with a maximum payment rate of 720 Yuan (about $96) per day. However, in this study, only 0.1% of pregnant women in the OZ 13 disease group met the eligibility criteria. If the DRG system awards higher payments for patients who stay longer in hospitals, it may improve the management of the OZ 13 disease group. This practice is observed in some European countries, such as France [40, 41]. At the same time, there may be some

unintended consequences of the DRG payment, such as patients may receive inadequate treatment, be discharged prematurely, or experience selective admission practices. These issues arise because hospitals face pressure to contain costs, which can significantly affect the payment standards for the OZ 13 disease group [42].

Limitations

However, this study has several limitations. Firstly, this is a single-center investigation, which may limit the internal validity of the findings and make it challenging to generalize the results to other populations or healthcare settings. We aim to address this limitation by conducting a multicenter study in the future. Secondly, the lack of data from hospital databases hinders our ability to directly assess indicators of pharmaceutical affairs management, such as defined daily doses, defined daily costs, and the consumption index of antibacterial drugs.

Conclusions

The research findings suggest that Diagnosis-Related Groups (DRG) can effectively utilize the expertise of multidisciplinary team members, significantly shorten the length of hospital stays, and control medical expenses. Consequently, this enhances the efficiency and capacity of hospital management and optimizes the allocation of medical resources. The involvement of clinical pharmacists in DRG management can provide more precise and timely support for the rational use of drugs. However, to enhance the flexibility of DRG payment, adopting a hybrid payment model like the one used in high - income countries such as Germany and France. This payment model could address the under - reimbursement of DRG for high - risk pregnancy populations. Concurrently, strengthening DRG audit frameworks to ensure adequate treatment and prevent premature discharges or split hospitalizations.

Abbreviations

OB13	Cesarean Section with General Complications and Comorbidities
OC13	Vaginal Delivery with Surgical Operation, with General Complications and Comorbidities
OC19	Vaginal Delivery with Surgical Operation, with Painless
OZ13	Other Pregnancy-Related diseases, with General Complications and Comorbidities
OZ15	Other Pregnancy-Related diseases without Complications and Comorbidities
OB11	Cesarean Section with Severe Complications and Comorbidities
OB15	Cesarean Section without Complications and Comorbidities
OC11	Vaginal Delivery with Surgical Operation, with Severe Complications and Comorbidities
OR13	Vaginal Delivery with General Complications and Comorbidities
OF13	Mid-Trimester Induced Abortion Procedures with General Complications and Comorbidities
OD23	Pregnancy-Related Vulvar, Vaginal, and Cervical Procedures with General Complications and Comorbidities
OC15	Vaginal Delivery with Surgical Operation without Complications and Comorbidities
OZ11	Other Pregnancy-Related Diseases with Severe Complications and Comorbidities
OF15	Mid-Trimester Induced Abortion Procedures without Complications and Comorbidities
OR19	Vaginal Delivery with Pain Management
OS23	Abortion-Related Diseases with General Complications and Comorbidities
OS13	Puerperium-Related Diseases with General Complications and Comorbidities
OR15	Vaginal Delivery without Complications and Comorbidities
OF11	Mid-Trimester Induced Abortion Procedures with Severe Complications and Comorbidities
OJ13	Other Pregnancy/Delivery-Related Surgical Procedures with General Complications and Comorbidities
OF23	Early Abortion Surgical Procedures with General Complications and Comorbidities
OR11	Vaginal Delivery with Severe Complications and Comorbidities
OS15	Puerperium-Related Diseases without Complications and Comorbidities
OD25	Pregnancy-Related Vulvar, Vaginal, and Cervical Diseases without Complications and Comorbidities
OS25	Abortion-Related Diseases without Complications and Comorbidities
OD13	Pregnancy-Related Uterine and Adnexal surgical Procedures with General Complications and Comorbidities
OJ15	Other Pregnancy/Delivery-Related surgical Procedures without Complications and Comorbidities
OF21	Early Abortion Surgical Procedures with Severe Complications and Comorbidities
OD21	Pregnancy-Related Vulvar, Vaginal, and Cervical surgical Procedures with Severe Complications and Comorbidities
OF25	Early Abortion Surgical Procedures without Complications and Comorbidities
OS11	Puerperium-Related Diseases with Severe Complications and Comorbidities
OS21	Abortion-Related Diseases with Severe Complications and Comorbidities

Acknowledgements

Thanks to my hospital for providing support for my research.

Authors' contributions

Qiqin Zhang: Visualization, Writing-original draft, Writing-review & editing; Geer Zhang: Writing-original draft, Writing-review & editing; Shuangneng Yang: Resources, Writing-review & editing; Meng Zhang: Writing-review & editing; Shujuan Shu: Writing-review & editing; Mengdan Zhao: Software, Supervision, Funding acquisition, Data curation, Writing-review & editing.

Funding

Not applicable.

Data availability

The original contributions presented in the study are included in the article material. The data for this study are part of the hospital and health insurance databases and are not publicly available. Access to the datasets can be directed to the corresponding authors.

Declarations

Ethics approval and consent to participate

The studies involving human participants are reviewed and approved by the Ethics Committee of Women's Hospital, Zhejiang University School of Medicine (NO. IRB-20230, 089-R). These studies were conducted in accordance with the Declaration of Helsinki. Despite the waiver for written consent, verbal informed consent was obtained from all participants, as the research involved minimal risk and fully anonymized data. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 6 March 2025 / Accepted: 14 May 2025
Published online: 28 May 2025

References

1. Getachew T, Negash A, Debella A, Yadeta E, Lemi M, Balis B, Balcha T, Bekele H, Abdurke M, Alemu A, Shiferaw K, Eyeberu A. Prevalence and adverse outcomes of twin pregnancy in Eastern Africa: a systematic review and meta-analysis. BMC Pregnancy Childbirth. 2024;2(1):169.
2. Chaudhary N, Newby AN, Whitehead KA, Non-Viral RNA. Delivery during pregnancy: opportunities and challenges. Small. 2024;2(41):e2306134.
3. Tan J, Xiong Y, Liu C, et al. A population-based cohort of drug exposures and adverse pregnancy outcomes in China (DEEP): rationale, design, and baseline characteristics. Eur J Epidemiol. 2024;3(4):433–45.
4. Richardson JL, Moore A, Bromley RL, Stellfeld M, Geissbühler Y, Bluett-Duncan M, et al. Core data elements for pregnancy pharmacovigilance studies using primary source data collection methods: recommendations from the IMI ConcePTION Project. Drug Saf. 2023;46(5):479–91.
5. Patel A, Sushko K, Mazer-Amirshahi M, et al. Availability of safe and effective therapeutic options to pregnant and lactating individuals following the united States food and drug administration pregnancy and lactation labeling rule. J Pediatr. 2023;259:113342–113342.
6. Pfaller B, José Yepes-Nuñez J, Agache I, Akdis CA, Alsalamah M. Biologicals in atopic disease in pregnancy: An EAACI position paper. Allergy. 2021;7(1):71–89.
7. McGhan WF, Larson LN, Raisch DW. The effects of DRGs and cost-containment: assessment by hospital pharmacy directors. Hosp Formul. 1986;2(8):870.
8. Cao Z, Liu X, Wang X, Guo M, Guan Z. Impacts of DRG-Based prepayment reform on the cost and quality of patients with neurologic disorders: evidence from a quasi-experimental analysis in Beijing, China. Risk Manag Healthc Policy. 2024. https://doi.org/10.2147/RMHP.S458005.
9. Li X, Zhang Y, Zhang XY, Li XY, Lin X. Effects of fee-for-service, diagnosis-related-group, and mixed payment systems on physicians' medical service behavior: experimental evidence. BMC Health Serv Res. 2022. https://doi.org/10.1186/s12913-022-08218-5.
10. Chang W, Yan X, Ling H, Liu T, Luo A. A study of the types and manifestations of physicians' unintended behaviors in the DRG payment system. Front Public Health. 2023;11:1141981.
11. Xiang X, Dong L, Qi M, Wang H. How does diagnosis-related group payment impact the health care received by rural residents? Lessons learned from China. Public Health (London). 2024;232:68–73.
12. Lin A, Hou J. Diagnosis-Related groups payment reform and hospital cost control. Technol Health Care. 2024:1–8. https://doi.org/10.3233/THC-240110.
13. Jermini M, Fonzo-Christe C, Blondon K, Milaire C, Stirnemann J, Bonnabry P, et al. Financial impact of medication reviews by clinical pharmacists to reduce in-hospital adverse drug events: a return-on-investment analysis. Int J Clin Pharm. 2024;46(2):496–505.
14. Cossu G, Belouaer A, Kloeckner J, et al. The enhanced recovery after surgery protocol for the perioperative management of pituitary neuroendocrine tumors/pituitary adenomas. NeuroSurg Focus. 2023;55:E9–9.
15. Tian W, Zhang S, Gao Y, Wang Y, Cui Q. Drug utilization reviews to reduce inappropriate drug use and pharmaceutical costs in inpatients based on diagnosis-related group data. Technol Health Care. 2024;32:4353–63.
16. Zhao YY, Yan XL, Zhu CP, Li XL. Cost and related factors analysis for patients undergoing colon polyp surgery based on DRG mode. Eur Rev Med Pharmacol Sci. 2023;2(16):7582–9.
17. Gollnick J, Zeschick N, Muth J, Hörbrand F, Behnke K, Killian P, et al. Controlling prescribing through preferred drug Targets—The Bavarian experience. Int J Environ Res Public Health. 2024;21(9):1174.
18. Zou K, Li H-Y, Zhou D, Liao Z-J. The effects of diagnosis-related groups payment on hospital healthcare in China: a systematic review. BMC Health Serv Res. 2020;2(1):112.
19. Tan H, Zhang X, Bi S, Chen Y, Guo D. How significant is cost-shifting behavior under the diagnosis intervention packet payment reform? Evidence from the coronary heart disease market. Front Public Health. 2024;12:1431991.
20. Schneeweiss S, Desai RJ, Ball R. A future of data-rich pharmacoepidemiology studies: transitioning to large-scale linked electronic health record + claims data. Am J Epidemiol. 2025;194(2):315–21.
21. Kim MK, Rouphael C, Mcmichael J, Welch N, Dasarathy S. Challenges in and opportunities for electronic health Record-Based data analysis and interpretation. Gut Liver. 2024;18(2):201.
22. Locatelli A, Bellante N, Donatiello G, et al. Antihypertensive therapy during pregnancy: the prescription pattern in Italy. Front Pharmacol. 2024;15:1370797.
23. Mo G, Zhu E, Fang X, Ma J, Kong S, Guo X, et al. Evaluation of the effect of DRG payment policy based on interrupted time series modeling: evidence from a tertiary hospital in Anhui Province. Health Res Policy Syst. 2024;2(1):167–13.
24. Bellanger MM, Quentin W, Tan SS. Childbirth and diagnosis related groups (DRGs): patient classification and hospital reimbursement in 11 European countries. Eur J Obstet Gynecol Reprod Biol. 2013;16(1):12–9.
25. Liu Y, Du S, Cao J, et al. Effects of a Diagnosis-Related group payment reform on length and costs of hospitalization in Sichuan, China: A synthetic control study. Risk Manag Healthc Policy. 2024:1623–37. https://doi.org/10.2147/RMHP.S463276.
26. Meng Z, Hui W, Cai Y, Liu J, Wu H. The effects of DRGs-based payment compared with cost-based payment on inpatient healthcare utilization: A systematic review and meta-analysis. Health Policy. 2020;12(4):359–67.
27. Li Q, Fan X, Jian W. Impact of Diagnosis-Related-Group (DRG) payment on variation in hospitalization expenditure: evidence from China. BMC Health Serv Res. 2023;2(1):688.
28. Teng J, Li Q, Song G, Han Y. Does the Diagnosis-Intervention packet payment reform impact medical costs, quality, and medical service capacity in secondary and tertiary hospitals?? A Difference-in-Differences analysis based on a Province in Northwest China. Res Rep Clin Cardiol. 2024;17:2055–65.
29. Liu Y, Wang G, Qin T, Kobayashi S, Karako T, Song P. Comparison of diagnosis-related groups (DRG)-based hospital payment system design and implementation strategies in different countries: the case of ischemic stroke. Biosci Trends. 2024:202301027. https://doi.org/10.5582/bst.2023.01027.
30. Park T, Kim H, Song S, Griggs SK. Economic evaluation of Pharmacist-Led digital health interventions: A systematic review. Int J Environ Res Public Health. 2022;1(19):11996.
31. Price E, Shirtcliffe A, Fisher T, Chadwick M, Marra CA. A systematic review of economic evaluations of pharmacist services. Int J Pharm Pract. 2023;31(5):459–71. https://doi.org/10.1093/ijpp/riad052.
32. Shrestha S, Shrestha R, Ahmed A, Sapkota B, Khatiwada AP, Christopher CM, et al. Impact of pharmacist services on economic, clinical, and humanistic outcome (ECHO) of South Asian patients: a systematic review. J Pharm Policy Pract. 2022;1(1):37.
33. Thao V, Sharpe EE, Dholakia R, Ahn HH, Moriarty JP, Borah BJ, Gill MC, Theiler RN. Evaluating the cost-effectiveness of testing pregnant women for penicillin allergy. PLoS ONE. 2023;1(1):e0280151.
34. Baudouin A, Herledan C, Poletto N, Guillemin M-D, Maison O. Economic impact of clinical pharmaceutical activities in hospital wards: A systematic review. Res Soc Adm Pharm. 2020;1(3):497–505.
35. Gao S, Wang X, Lu Y, Liu Y, Jiang Q. Current scenario and challenges of clinical pharmacists to implement pharmaceutical care in DRG/DIP payment hospitals in China: a qualitative interview study. Front Public Health. 2024. https://doi.org/10.3389/fpubh.2024.1339504.
36. Li M, Yang J, Shen J, Xu J, Gu D. Analysis of the impact of China healthcare security diagnosis-related groups payment reform on the hospitalization costs for uvulopalatopharyngoplasty in obstructive sleep apnea patients at hospital C. BMC Health Serv Res. 2024;24:1514.
37. Mathauer I, Wittenbecher F. Hospital payment systems based on diagnosis-related groups: experiences in low- and middle-income countries. Bull World Health Organ. 2013;9(10):746–56.
38. Blackburn CW, Du JY, Marcus RE. Elective THA for indications other than osteoarthritis is associated with increased cost and resource use: A medicare database study of 135, 194 claims. Clin Orthop Relat Res. 2024;48(7):1159–70.
39. Xiang X, Li Y, Liang N, Wang B, Wang H. Assessing healthcare payment reforms' effects on economic inequities and catastrophic expenditures among cancer patients in ethnic minority regions of China. BMC Med. 2025;23(1):208–18.
40. Quentin W, Stephani V, Berenson RA, Bilde L, Grasic K, Sikkut R, et al. How Denmark, England, Estonia, France, Germany, and the USA pay for variable, specialized and low volume care: A Cross-country comparison of In-patient payment systems. Int J Health Policy Manage. 2022;1(12):2940–50.
41. Spangler D, Linder W, Winblad U. The impact of the Swedish care coordination act on hospital readmission and Length-of-Stay among Multi-Morbid elderly patients: A controlled interrupted time series analysis. Int J Integr Care. 2023;23(2):1–15.
42. Messerle R, Schreyögg J. Country-level effects of diagnosis-related groups: evidence from Germany's comprehensive reform of hospital payments. Eur J Health Econ. 2024;25(6):1013–30.

Publisher's Note