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Improving the Quality of Care for Women with Pregnancy-Induced Hypertension Reduces Costs in Tver, Russia

April 2002



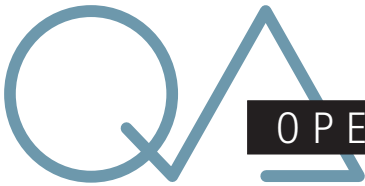


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The Quality Assurance (QA) Project is funded by the U.S. Agency for International Development (USAID), under Contract Number HRN-C-00-96-90013. The QA Project serves countries eligible for USAID assistance, USAID Missions and Bureaus, and other agencies and nongovernmental organizations that cooperate with USAID. The QA Project team, which consists of prime contractor Center for Human Services, Joint Commission Resources, Inc., and Johns Hopkins University (including the School of Hygiene and Public Health, the Center for Communication Programs [CCP], and the Johns Hopkins Program for International Education in Reproductive Health [JHPIEGO]), provides comprehensive, leading-edge technical expertise in the design, management, and implementation of quality assurance programs in developing countries. Center for Human Services, the non-profit affiliate of University Research Co., LLC, provides technical assistance and research for the design, management, improvement, and monitoring of health systems and service delivery in over 30 countries.



Improving the Quality of Care for Women with Pregnancy-Induced Hypertension Reduces Costs in Tver, Russia

Abstract

The Quality Assurance Project/Russia implemented a quality improvement (QI) demonstration project in 1998 at three hospitals in Tver Oblast, Russia. The project sought to improve the quality of care for women with pregnancy-induced hypertension (PIH), then the single largest cause of maternal deaths in Tver. Central to the QI effort was the development and introduction of evidence-based clinical guidelines for the management of PIH. The new guidelines rationalized admission criteria and the use of drugs, reduced the number of PIH admissions, and called for more aggressive treatment of PIH.

Health outcomes improved following the introduction of the new guidelines. Complications in newborns of PIH mothers dropped, no PIH case progressed to eclampsia (which is often fatal), and no maternal deaths caused by PIH occurred in the 15 months following the implementation of the new guidelines.

A before-and-after cross-sectional cost study at two of the three pilot hospitals found that PIH admissions decreased by 77 percent in the six months following introduction of the new guidelines compared to the previous six months (from 47 cases before to 11 after). This decrease is consistent with the new, more stringent guidelines and indicates a high likelihood that compliance with the new guide-

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lines caused the decrease. The cost study measured PIH-related direct costs for inpatient and outpatient cases. The former included the cost of hospitalization (clinical services, food), drugs, lab tests and other paraclinical services. The latter included antenatal care-related costs and costs associated with PIH and other conditions: drugs, lab and other paraclinical care, and medical consultations.

Total direct inpatient-related costs decreased by 86 percent, from about 51,000 rubles in the Before group to about 7,000 rubles in the After group. This is an annualized savings of about 118,000 rubles (about US\$ 4,720 at the time of the study). Direct per-inpatient costs decreased 41 percent. As expected, costs were higher for women with more severe PIH, but a substantial decrease was evident at all severity levels following the introduction of the new guidelines, with the larger decreases occurring in the more severe cases. Length of hospital stay for PIH women also decreased, on average from 13.5 to 11.8 days. Findings also suggest that outpatient costs potentially associated with PIH care also dropped by roughly 13,000 rubles per year, although an inability to separate PIH costs from regular antenatal care costs makes it difficult to pinpoint the decrease with certainty.

Although the number of cases in each study group is small, and numerous assumptions are made in the analysis, no substantial threats to the validity of these findings are apparent. The unusual result of having health outcomes improve at substantially lower operating costs recommends wider application of the demonstration project.

Acknowledgements

This paper was written by Hany Abdallah, Olga Chernobrovkina, Anna Korotkova, Rashad Massoud, and Bart Burkhalter. The Health Department of the Tver Oblast under the stewardship of Dr. Alexander N. Zlobin, Torzhok Hospital, and the Vyshny Volochyok Hospital greatly supported and participated in the study.

The staff of Torzhok Hospital and Vyshny Volochyok Hospital significantly facilitated the coherent and successful execution of the study. Special thanks to Marina Scheglova, Economist with the Tver Fund. The authors also recognize and appreciate the special effort and work of: Dr. Valeria Gerasimova, Obstetrician-Gynecologist (Ob/Gyn), Dr. Andrey Gulin, Ob/Gyn, and Irina Kutilina, Hospital Economist, Torzhok Hospital; Dr. Michail Klimov, MD and Head of Perinatal Care, Dr. Natalia Suchova, Ob/Gyn, and Olga Klueva, Hospital Economist, Vyshny Volochyok.

Paula Tavrow and Jolee Reinke from the University Research Co., LLC,-Center for Human Services (URC-CHS) provided extensive technical input. Special thanks to Marc Oliver for his unwavering encouragement, and Beth Goodrich who edited this paper with diligence and a ready smile.

While we acknowledge the valuable contributions of the parties mentioned above, all errors of omission and/or interpretation remain the sole responsibility of the authors.

Recommended citation

Abdallah, H., O. Chernobrovkina, A. Korotkova, R. Massoud, and B. Burkhalter. 2002. Improving the Quality of Care for Women with Pregnancy-Induced Hypertension Reduces Costs in Tver, Russia. *Operations Research Results* 2(4). Bethesda, MD: Published for the United States Agency for International Development (USAID) by the Quality Assurance Project.

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Improving the Quality of Care for Women with Pregnancy-Induced Hypertension Reduces Costs in Tver, Russia

Hany Abdallah, Olga Chernobrovkina, Anna Korotkova, Rashad Massoud, and Bart Burkhalter

Abbreviations

AHRQ	Agency for Health Research and Quality, Tver Oblast Department of Health
BP	Blood pressure
C-section	Cesarean section
EBCG	Evidence-Based Clinical Guidelines
Mg SO ₄	Magnesium sulfate
Ob/Gyn	Obstetrician-gynecologist
PIH	Pregnancy-induced hypertension
QA	Quality assurance
QI	Quality improvement
RFMOH	Russian Federation Ministry of Health
SOW	Scope of work
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics

1. Introduction

The Health Committee of the U.S.-Russia Joint Commission on Economic and Technological Cooperation defined the scope of work (SOW)¹ in 1998 for cooperative activities to improve quality. The activities included the implementation of a demonstration project to improve the quality of maternal and child health services in Tver Oblast. Funded by the U.S. Agency for International Development (USAID), the Quality Assurance (QA) Project provided technical assistance to those undertaking the SOW, including the development of the demonstration project. A collaboration was formed and included the Ministry of Health of the Russian Federation (RFMOH), the Central Public Health Research Institute of the RFMOH, the Tver Oblast Department of Health's Agency for Health Research and Quality (AHRQ), the U.S. Department of Health and Human Services, USAID, and the QA Project.

Key decision makers held a planning meeting in Tver that included a review of existing data. Shortly thereafter, pregnancy-induced hypertension (PIH)² was selected as

the maternal health priority for the demonstration project. As the single largest cause of maternal deaths in Tver, PIH accounted for seven of the 25 reported maternal deaths that had occurred in Tver in the previous three years (1995–97). Additionally, the diagnosis and management of PIH was causing much confusion and difficulty. Interestingly, toxemia was diagnosed in 18 percent of pregnancies during 1997;³ the worldwide incidence of PIH is 5–6 percent of pregnancies (Murray and Lopez 1998).

The demonstration project was launched at three hospitals in Tver Oblast: Tver City Maternity Hospital #1, Vyshny Volochyok Hospital, and Torzhok Central District Hospital. As part of the improvement in the system of care, new guidelines for PIH care based on evidence-based medicine were developed and implemented in these hospitals, and indicators were developed and tracked monthly using time series charts to show the effect of the new system on the quality of care. Section II describes the quality improvement effort and the effect of the new evidence-based guidelines.

A cost study was conducted concurrently, during the spring of 2000. It quantified the economic impact of the improved system of PIH care. This report documents the cost study's methodology and

findings. Documenting the cost of quality improvement is important in part because of the paucity of such information and growing recognition of the need for evaluations of the economic impact of quality improvement and evidence-based guidelines (Eccles et al. 2000; Haycox et al. 1999).

II. The Quality Improvement Intervention

The QA Project/Russia team developed the new system of PIH care using a quality improvement methodology (Massoud et al. 2001; Langley et al. 1996) that includes a framework for clinical quality improvement (Batalden and Stoltz 1993) and emphasizes the need to integrate clinical content (subject matter knowledge) with the improvement methodology. The improvement methodology consists of four phases that integrate a systematic six-step process for developing evidence-based clinical guidelines (EBCG) (Tula Oblast Health Care Department et al. 2001; Tver Oblast Health Care Department et al. 2001a and b).⁴

Phase I of the improvement methodology was to *identify* the problem needing improvement. Key decision makers had agreed at the Tver planning meeting to work on improving the system of care for women suffering from toxemia/PIH. They chose three hospitals representing the different types of rural and urban facilities that provide toxemia/PIH care in Tver to participate in the demonstration project: Tver City Maternity #1, Vyshny Volochyok Hospital, and Torzhok Rayon Hospital. A team of the different professional functions

involved in the system of PIH care was formed at each hospital. The teams included obstetricians, gynecologists, other physicians, midwives, and nurses. All team members were trained in quality improvement concepts and methods before embarking on the improvement process.

Phase II was to *analyze* the existing system of toxemia/PIH care. The system analysis was done at each facility and included the referral systems (including ambulance service) connecting the facilities. For each hospital, the teams flowcharted the entire PIH care system. Next they documented existing clinical practices at each step in the flowcharted processes, including clinical diagnostic criteria, referral criteria, and treatment guidelines. This analysis revealed the differences in practice among the hospitals: inconsistencies in diagnosis and treatment, as well as organizational problems. What had been thought to be a standardized system of care proved to have significant variation. Importantly, the main strategy for treating PIH was to admit women to the hospital and then attempt to control blood pressure while maintaining the pregnancy. This approach contrasts significantly from that of the western world, which stresses more stringent admission criteria and more aggressive treatment of those admitted. The teams also developed indicators to show changes that might result from their efforts. Starting with January 1998, the teams collected data retrospectively from records at hospitals and women's clinics. The data were collected for the total population (no sampling), aggregated monthly, and displayed on time series graphs. Two different databases were set up, one for data

from hospital records and the second for data from the associated women's clinics.

Phase III of the improvement methodology was to *develop* interventions that the teams believed would yield improvement. First, the teams reviewed the available evidence-based literature on PIH care, using special training sessions about the existing evidence base in the literature where appropriate. Second, to update the clinical content in accordance with the best available evidence and to achieve agreement on clinical content changes, several clinical review and policy dialogue sessions were held over a period of some six months. These changes adopted recommendations from the 10th International Classification of Diseases (ICD-10 1992). Also adopted was a radical change to manage PIH by inducing early delivery and preventing eclampsia with intravenous magnesium sulfate (Figure 1). Third, plans were developed to enhance the capacity of the systems of care to implement the updated clinical content. New flowcharts were drawn showing the proposed changes. Fourth, the indicators were reviewed and updated to ensure that they measured the clinical and organizational changes introduced.

Phase IV was to *test and implement* the changes agreed upon and to show whether they actually yielded improvement. This was accomplished using the "Shewhart Cycle for Learning and Improvement," also known as the Plan-Do-Study-Act (PDSA) Cycle (Shewhart 1931). The teams pilot tested the proposed interventions for a few months to see if they were feasible and worked. Data from the proposed interventions convinced the teams that the

Figure 1
Major Differences between Old and New Guidelines for Treating PIH in Hospitals

Old	New
Many pregnant women diagnosed with toxemia	Fewer pregnant women diagnosed with PIH
Poly-drug therapy	Mono-drug therapy (magnesium sulfate: Mg SO4)
Inpatient management of hypertension	Prevention of eclampsia
Prolonged pregnancy	Early and induced delivery

proposed interventions worked: the teams observed improved care for patients admitted and managed in the hospital and saw no complications in those not admitted.

The hospitals began implementing the new standards during the development process: Torzhok and Vyshny Volochyok hospitals started first, followed by Tver City Maternity. The director of the Tver Oblast Department of Health and the chief obstetrician/gynecologist (Ob/Gyn) of the RFMOH officially authorized the three demonstration hospitals to implement the new system of care in September 1999. A conference in late September officially launched the new system and was attended by all facility administrators, clinical chiefs, and others involved in the project (Ethier forthcoming).

III. Effects on Health Outcomes

Several indicators of health outcome were investigated at the three demonstration hospitals. These included: (1) number of toxemia/PIH cases progressing to eclampsia, (2) number of toxemia/PIH deaths, and (3) number of newborns with complications to toxemic/PIH

women. The study team collected data on cases progressing to eclampsia and/or resulting in death over the 19 months after implementation of the new guidelines (October 1999–April 2001). Data were obtained from the monitoring system developed as part of the new quality assurance system for PIH care. Because such data were not collected during the period before the new guidelines, data on deliveries to PIH women and newborn complications were obtained from hospital records during a six-month period before the new system was implemented (January 1999–June 1999).

The following results were found:

1. No cases progressed to eclampsia among the women managed under the new system of care. This is the most important indicator reflecting that the new system of care is an improvement.
2. No deaths occurred among the women managed in the new system of PIH care.
3. Complications of newborns of women with PIH dropped 60 percent.

IV. Cost Study Design and Methods

The cost study used a before-and-after cross-sectional design. Cost data were collected from two of the three hospitals that participated in the demonstration pilot: Torzhok Hospital and Vyshny Volochyok. Data were collected retrospectively from medical records over a 15-month period (January 1999–March 2000). The Before data were collected for months 1 to 6 (January–June 1999), the new guidelines were implemented in months 7 to 9 (July–September 1999), and the After data were collected in months 10 to 15 (October 1999–March 2000).⁵ Cost data were not collected from Tver Maternity Hospital because it had delayed implementation of the new guidelines.

A. Inpatient Costs

To estimate inpatient costs, we reviewed medical records for all pregnant women who were admitted with suspected PIH of any severity to the two hospitals during the study period. Data were obtained only for elements of maternity care that were expected to change as a result of the new guidelines. Elements that were expected to change included drugs, laboratory tests, and direct care associated with hospitalization. Hospitalization care included physician and nursing time, and food. The cost of all these elements is referred to as “direct costs.”

Costs not included because we did not expect the new guidelines to affect them included imputed rent for infrastructure (buildings and equipment), hospital supplies and materials, special procedures (such as C-sections), and hospital staff other than doctors and nurses.

We used the following procedures to estimate the direct cost of the three elements of inpatient care:

Drugs. First, we examined each PIH patient's medical record to determine the number of doses of each type of drug she had received. Second, we estimated the average cost-per-dose of a particular type of drug by finding the average price paid for that type of drug by each hospital during the Before and After periods. The average for each hospital was assumed to be the midpoint between the average Before price and the average After price for that hospital. Thus, for each hospital the cost per dose of a particular type of drug was assumed to be the same in the Before and After groups. Third, the number of doses was multiplied by the estimated average cost per dose in each hospital to obtain the total cost to the hospital of each type of drug for each patient.

A special study estimated drug costs borne by the patient (and/or her family) at Vyshny Volochyok. This information was used to adjust total drug costs in both hospitals to include costs borne by the hospital and patient. The adjusted costs were summed across drug types, patients, and hospitals to obtain total drug costs in the Before and After groups. The total cost of drugs in each group was divided by the number of PIH patients in the group to obtain the average drug cost per patient in each group.

Laboratory tests. Lab test costs include the costs of tests and paraclinical services such as blood exams, urinalyses, and electrocardiograph readings. The procedure used to estimate the total cost of laboratory tests for PIH patients and the average cost per patient was

similar to the procedure used for drugs, except that no patient-borne costs were involved. We obtained data on the number of tests by type from each patient's medical record; we estimated the average cost per test in each hospital from hospital financial records; and we calculated total costs by summing across types of tests and patients. The cost per test was based on the cost of materials and supplies used to perform the tests and services.

Hospitalization. Hospitalization here refers to the elements of care that are directly associated with occupying a bed in the hospital's maternity ward; their cost is roughly proportional to the number of beds occupied. In this study, we summed the cost of three elements of care thought to be influenced by the new guidelines (physician time, nursing time, and food) to obtain an indicator of the direct cost of hospitalization. To obtain an estimate of the direct hospitalization cost per day per bed, we obtained the annual budget for the three elements during the Before and After periods from the financial records of each hospital. The budget reports yielded a total annual direct cost of hospitalization for each hospital and each period. The total direct cost was divided by 365 and by the number of maternity beds in the hospital to obtain the average daily hospitalization cost per bed.

B. Outpatient Costs

Although the study team believed that outpatient costs for PIH patients would not change appreciably as a result of the new guidelines, the potential for questions about outpatient costs led us to collect data on such costs. While screening

for PIH occurred during regular antenatal care visits both before and after the implementation of the new guidelines, under the new guidelines, no special care or attention was prescribed for PIH at the outpatient level. Patients who showed signs of slightly elevated blood pressure (mild hypertension) but who tested negative for protein in the urine (proteinuria) were considered at risk for developing PIH under the new guidelines and were typically asked to return to the outpatient facility within a few days for follow up. Any patient with this profile without easy or immediate access to an emergency facility would be referred for admission to the hospital.

Prior to the implementation of the new guidelines, treatment at the outpatient level for pregnant women considered at risk for toxemia/PIH was more intensive. In the old system, patients typically received more attention, including more monitoring and treatment (both at home and in the outpatient facility). In addition, some women who were considered at risk also received referrals for hospital admission—up to two or three admissions per pregnancy.

Information about outpatient care for women with toxemia under the old system is mainly anecdotal, so it is difficult to distinguish between care that was provided as part of regular antenatal care visits and toxemia/PIH care. Consequently, information on all elements of care received by the pregnant woman at the outpatient level was collected, including all regular antenatal care. Three elements of outpatient care were investigated: drugs, paraclinical services (mainly lab tests), and medical consultations (e.g., with the

Ob/Gyn). The cost of each element was obtained in the same manner as the corresponding elements of inpatient costs. The cost of medical consultation was assumed to be proportional to the number of outpatient visits, with the cost per visit equal to the per unit cost used in the hospital budget reports. Other outpatient costs were not estimated, including costs associated with undetected PIH cases, if there were any, that were not admitted under either set of guidelines. We assumed that all of these unmeasured costs were constant in the Before and After periods.

The outpatient medical records of all women were screened to identify cases with a toxemia/PIH diagnosis in the Before and After periods. This included women admitted to the hospital, those treated only as outpatients, and those who were referred to a hospital as possible PIH cases but classified as not being at risk following referral. Women in the After period who were not diagnosed with PIH, but who would have been treated for toxemia under the old guidelines, were not included as a PIH case. We assumed that PIH had no effect on the outpatient treatment and cost of cases not identified by this screening. We abstracted and analyzed outpatient cost data for the PIH cases identified in this screening. As with the inpatient analysis, the analysis of the outpatient data assumed that the number and severity of cases was the same in the Before and After periods, and that the pattern of regular antenatal care visits was the same.

A team made up of an Ob/Gyn responsible for treating the admitted women and a hospital economist was responsible for measuring and

Table 1
Number of Hospitalized PIH Cases Included in the Cost Study, by Severity and Hospital

Severity	Before			After			Total (Percentage Reduction)
	Torzhok	Vyshny Volochoyok	Total	Torzhok	Vyshny Volochoyok	Total	
Mild	19	14	33	1	5	6	39 (82%)
Moderate	8	3	11	0	3	3	14 (73%)
Severe	3	0	3	1	1	2	5 (33%)
Total	30	17	47	2	9	11	58 (77%)

allocating costs to the elements of care. Data were analyzed using Microsoft Access and Excel software.

V. Cost Study Findings

A. Number of PIH Cases

Inpatient cases. In the two study hospitals combined, 47 PIH cases were admitted in the six months prior to the implementation of the new guidelines and only 11 in the six months after, a 77 percent drop. This reduction in admissions indicates the degree to which the new guidelines were successfully implemented (see Section VI on assumptions and threats to validity).

As shown in Table 1, a larger proportion of the admitted cases in the After group presented with moderate to severe cases of PIH (5 of 11: 45 percent) than in the Before group (14 of 47: 30 percent). We hypothesized that the increased proportion of severe cases would increase the average cost and examine our hypothesis below.

Outpatient cases. We found 56 records of women with PIH who

received outpatient care, 47 in the Before period and 9 in the After period (Table 2). Twelve patients (9 Before and 3 After) diagnosed with PIH were not hospitalized. These 12 included patients with mild forms of PIH. Note that some women admit-

Table 2
Number of Cases with PIH Seen as Outpatients, Including Cases Not Admitted

PIH Patients Seen as Outpatients	Before	After
Admitted for hospital care	38 ^[1]	6 ^[2]
Not admitted for hospital care	9 ^[3]	3
Total	47	9

Notes:

1. No records of outpatient care were found for 9 of the 47 hospitalized women in the hospitalized Before group (reported in Table 1). These patients were most likely hospital walk-ins.
2. Similarly, no records were found for 5 of the 11 hospitalized patients in the After group.
3. It is a coincidence that in the Before period, the number of women admitted for PIH who had not received outpatient care (9) equals the number diagnosed with PIH receiving outpatient care but not admitted for PIH.

ted with PIH do not appear to have received any outpatient care for PIH or for any other reason: 9 of the 47 women admitted with PIH in the Before period and 5 of the 11 women in the After period did not receive outpatient care.

B. Reduction in Direct Costs of Care for PIH Patients

Inpatient care

The total economic burden of treating pregnant women admitted to the hospital for PIH decreased following the implementation of clinical guidelines for PIH (Figure 2 and Table 3). Total direct inpatient costs for six months decreased from 51,247 rubles in the Before period to 7,071 rubles in the After period or 83 percent of Before costs in the two hospitals.⁶ Recall that the direct inpatient costs reported here reflect only the costs likely to change as a result of the new guidelines and not all the costs incurred by the hospital to treat PIH patients. Thus the savings of 44,176 rubles is likely to be a reasonable estimate of the PIH costs saved by the two hospitals as a result of the new guidelines, but *total* costs for treating PIH inpatients would not decrease by 83 percent because the total costs include costs not affected by the guidelines.

The large drop in the cost of PIH inpatient care was driven by two factors: a 76.6 percent decrease in the number of patients admitted for PIH, and a 41.0 percent decrease in the cost per inpatient (Table 3). The decrease in average-per-inpatient cost resulted from decreases in all three elements of inpatient care; the decreases in drug and hospitalization costs were much larger than the decrease in paraclinical services costs.

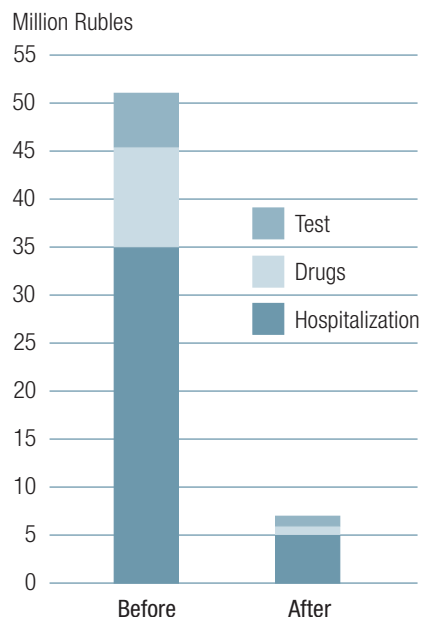
Table 3
Direct Cost of Inpatient PIH Care in Two Tver Hospitals before and after New PIH Guidelines^[1]

Elements of Care	Before (n = 47)		After (n = 11)		Percentage Change (n decreased 76.6%)	
	Average cost / patient	Total direct cost ^[1]	Average cost / patient	Total direct cost ^[1]	Average cost / patient	Total direct cost ^[1]
Hospitalization	744.4	34,987	457.1	5,028	- 38.6%	- 85.6%
Drugs	223.8 ^[2]	10,517	83.7	921	- 62.6%	- 91.2%
Paraclinical care (tests)	122.2	5,743	102.0	1,122	- 16.5%	- 80.4%
Total inpatient care	1,090.4	51,247	642.8	7,071	- 41.0%	- 86.2%

Notes:

1. All costs are in rubles. Total costs are for a six-month period in the Before and After columns and are subject to rounding error.
2. Average is based on 46 patients for whom drug data were collected; this average was projected to the 47th patient for whom data were missing.

Figure 2
Change in Total Cost of Inpatient Maternal Care for PIH Patients (Rubles) over 6-Month Periods



The distribution of inpatient costs among the three elements did not vary significantly between the two groups (Table 4). Hospitalization accounted for the largest portion of direct inpatient costs in both the Before and After groups (69 percent and 71 percent, respectively). The variation in the distribution of costs by case severity is discussed in a later section.

Table 4
Distribution of the Total Direct Inpatient Cost of PIH Treatment in the Two Hospitals Combined

Elements of Care	Before	After
Hospitalization	69%	71%
Drugs	20%	13%
Paraclinical care (tests)	11%	16%
Total inpatient cost	100%	100%

Outpatient care

Table 5 gives total outpatient care costs for all women treated for PIH (from Table 2) during the study periods. The outpatient costs reflect regular antenatal care plus PIH-related and other outpatient care received during the six-month Before and After study periods. The costs of outpatient care for women who received such care and were admitted for PIH averaged 409 rubles per patient before the new guidelines and 334 rubles after. The average per-patient costs of outpatient care for women who were not hospitalized dropped from 621 rubles to 266. This difference is statistically significant at the 0.01 level. However, the differences between the 409 and 334 figures and between the 334 and 266 figures are not statistically significant using a 2-tailed t-test. Overall there was a decrease of 30.7 percent in the per-patient cost of outpatient care for patients with a toxemia/PIH diagnosis.⁷

Because of the difficulty of separating costs associated with regular antenatal care from costs that are specifically related to treatment for PIH, it is difficult to project what proportion of the decrease in the cost of outpatient care is due to the implementation of the new guidelines. However, in the absence of any information on change in the antenatal care program for women⁸ during the period of the study, and because the data on outpatient drugs and lab tests among the 38 admitted patients who received outpatient care in the Before period show PIH-related treatment, it is likely that a large part or all of the 30.7 percent decrease in per-patient cost was due to the introduction of

Table 5
Total Direct Cost of All Outpatient Care During Six-Month Before and After Periods for Patients Diagnosed with PIH

Category of patient	Before			After			Percentage Change
	Average Cost/Patient	Number of Patients	Total Direct Cost	Average Cost/Patient	Number of Patients	Total Direct Cost	Average Cost/Patient
Admitted patients	409.3	38	15,553	334.0	6	2,004	-18.4%
Patients not admitted	621.0	9	5,588	266.5	3	800	-57.1%
Overall average	449.8	47	21,142	311.5	9	2,804	-30.7%

Notes: Costs include all outpatient costs whether or not related to PIH for women diagnosed with PIH and who received outpatient care in the Before or After period. All figures are in rubles and subject to rounding error.

the new guidelines. This finding is consistent with the expected impact of the new guidelines on outpatient care. In the Before group, women diagnosed with toxemia received more intensive attention and treatment as outpatients (including home-based care) than those in the After group where the new guidelines redefined the disease classification for PIH and hence the treatment provided. In the After group, only “border” PIH cases, i.e., those women with elevated blood pressure (BP) and no protein in their urine, received any “special” outpatient attention. They were typically asked to return sooner than their next scheduled antenatal visit to receive BP and urine protein tests. The rest, i.e., women diagnosed with PIH including proteinuria during an antenatal visit, immediately became inpatients.

Based on the above findings and assuming that the cost of PIH-related outpatient care is zero in the After group, the cost of PIH-related care at the outpatient level in the Before group is estimated to be

about 6,500 rubles over the six months in the Before group. This is an annualized saving of 13,000 rubles for the two hospitals. When the direct PIH-related outpatient costs are combined with the inpatient costs in Table 3, total costs in the six-month Before period equal 57,747 rubles (51,247+6,500) compared to 7,071 in the After period. This is an 87.7 percent drop.

The distribution of the cost of outpatient care changed only slightly following the implementation of the new guidelines (Table 6). The cost of consultations became relatively more important (45 percent of total per patient costs versus 41 percent in the Before group), while the cost of drug treatments became slightly less important (from 37 percent to 24 percent of total per patient costs). The relative cost of paraclinical care did not change from the Before to the After period.

Table 6
Average Cost per PIH Patient of Outpatient Care, by Element of Care and Group, in Rubles and as a Percentage of Total Average Cost per Patient

Group	Drug Cost	Paraclinical Cost	Consultation Cost	Total Cost
Before (n = 47)	122.5 (27%)	140.7 (31%)	186.6 (41%)	449.8 (100%)
After (n = 9)	75.6 (24%)	95.5 (31%)	140.5 (45%)	311.5 (100%)

Note: The total outpatient care cost by element and group was obtained first, and the average cost per patient by element and group was then obtained by dividing the total cost for each cell by the number of patients (n) in that group.

Direct cost of hospitalization

Total PIH inpatient days dropped from 635 before the implementation of the new guidelines to 130 afterward (a 79 percent reduction), largely as a result of the decrease in the total direct cost of hospitalization in both hospitals combined from 34,987 rubles to 5,028 rubles.⁹ The average direct cost of hospitalization per PIH inpatient decreased from 744 rubles to 457 rubles, a drop of 39 percent (Table 7 and Figure 3). The drop in inpatient days was caused by the 77 percent reduction in the total number of inpatients and a 13 percent reduction in the average length of stay per inpatient

(from 13.5 to 11.8 days). Length of stay varies significantly by case severity, as is addressed in a later section.

Direct cost of drugs for PIH inpatients

To analyze drug costs, we combined the cost of drugs provided by the hospital and those purchased by the patient and her family. The total cost dropped from 10,517 rubles in the Before group to 921 in the After group (Table 3). This large decrease was driven by the combination of fewer admissions for PIH and lower drug costs per inpatient in the After

group. The average per-patient cost dropped 63 percent (from 224 rubles before to 84 rubles after).

A special study of patient-paid inpatient drug costs at Vyshny Volochyok found that a higher proportion of inpatients in the After group (i.e., including both hospitals) paid for part of their own drugs than in the Before group. In the After group 6 of the 11 inpatients (55 percent) paid 59 percent of their

Figure 3
Reduction in the Average Direct Cost per PIH Inpatient of Hospitalization, Drugs, and Paraclinical Care for Both Hospitals Combined (Rubles)

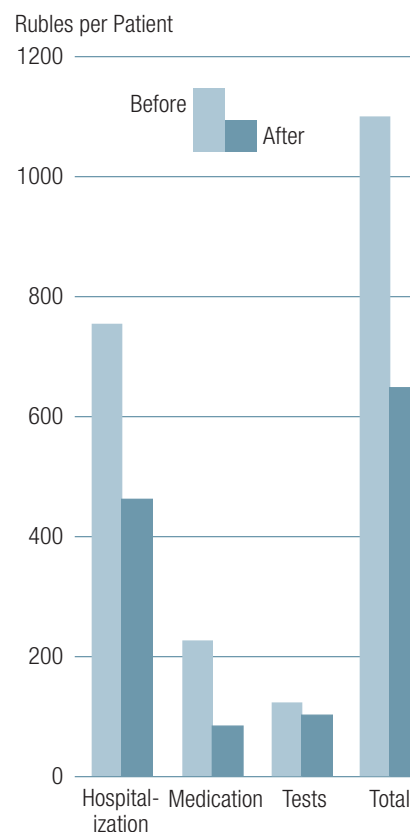


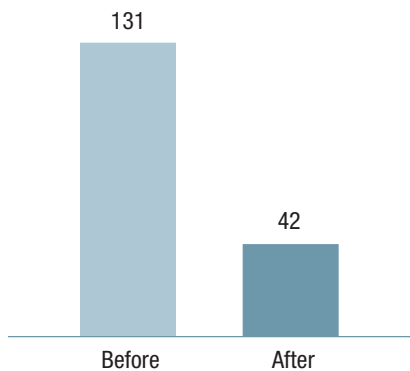
Table 7
Average Direct Cost of PIH Hospitalization per Day and per Stay for Both Hospitals Combined, before and after New Guidelines (Rubles)

	Before	After	Percentage Change
Average cost per day	55.1	38.7	-29.8 %
Average days per stay	13.5	11.8	-12.6 %
Average cost per stay	744	457	-38.6 %

Note: The average cost per day is based on the combined average cost of hospitalization in the two hospitals. Vyshny Volochyok has a lower per-day cost than Torzhok. While the average cost per inpatient in each hospital was assumed to stay constant during the course of the study, the change in average cost per day reported here reflects the relatively larger proportion of patients being admitted in Vyshny Volochyok hospital in the After group as compared to the Before group (Table 1).

drug costs, while in the Before group 10 of the 47 patients (21 percent) paid 67 percent of their drug costs. The total cost of inpatient drugs borne by the patients represented 13 percent of total inpatient drug costs in the Before group (both hospitals) and 28 percent in the After group (both hospitals).¹⁰ The average cost of drugs borne by a patient in Vyshny Volochyok fell 68 percent (from 131 rubles Before to 42 rubles After: Figure 4). The most important factor in reducing the cost to the patient was a 60 percent drop in the average number of drugs paid for by patients: from five to two.

Figure 4
Average Inpatient Drug Cost Borne by Patients at Vyshny Volochyok (Rubles)



Fewer types of drugs were used following the introduction of the new guidelines: 72 different types were used across all severity levels in the Before group and 32 in the After group. The average Before group inpatient received ten different drugs, and the average After group inpatient received six.

Table 8 illustrates the decreased polypharmacy. The six most fre-

quently used drugs in the Before group were used significantly less frequently or not at all in the After group. But other drugs (magnesium sulfate [Mg SO₄], clofellini, and Ringer solution) were used more frequently in the After group, in accordance with the new clinical guidelines. For example, the new guidelines recommend using Mg SO₄ to control convulsions. In the After group, a proportionately higher percentage of severe PIH cases—which are the cases most likely to need Mg SO₄—was admitted. We present an analysis of costs by case severity below.

Direct cost of paraclinical care for PIH inpatients

The total direct cost of paraclinical care including tests decreased from 5,743 rubles to 1,122, a drop of 80 percent (Table 3). The decrease in the number of women admitted for PIH accounted for most of this decrease. The average direct cost of all tests per inpatient also decreased (Table 3 and Figure 3), but not as dramatically as the costs of other elements. Direct costs dropped from 122 rubles per patient to 102, a 16 percent decrease.

The average number of tests per inpatient increased by about two following the implementation of the new guidelines. This pattern held for mild and severe PIH, but not for moderate, where the average number of tests per inpatient dropped from nine to five. Several

Table 8
Most Frequently Used Drugs to Treat PIH: Percentage Receiving Drug, by Group

Drug	Percentage of PIH Inpatients Receiving the Drug	
	Before (n=47)	After (n=11)
Papaverine hydrochloride	78%	8%
Glucose (40%)	69%	8%
Methylogobrevin	64%	23%
Dibasol	56%	Dis
Novocaine	50%	Dis
Diazepam	50%	Dis
Magnesium sulfate	42%	46%
Clofellini	30%	31%
Ringer solution	23%	43%

Notes: Frequently prescribed drugs are defined as those given to 50% or more of the PIH patients in either or both the Before and After groups. “Dis” means discontinued for PIH use under new guidelines, or 0%.

factors contributed to usage, including the type of test, the frequency of use per patient, and the unit cost of the test.

As illustrated in Table 9, frequently used tests in the Before group were also frequently used in the After group, although most dropped off a little, including electrocardiographs, a relatively expensive test. On the other hand, several tests infrequently used in the Before group became more popular after implementation, especially relatively expensive specialty consultations with ophthalmologists and therapists. The increased use of the proteinuria test was likely the result of increased monitoring of PIH inpatients according to the new guidelines.

Table 9
Frequently Used and Other Selected Tests and Consultations

	Percentage of Patients in Group Receiving Test	
	Before (n=47)	After (n=11)
Most Frequently Used		
Urinalysis	100%	100%
Total blood count	98%	45%
Blood platelet and coagulation	91%	73%
Blood biochemistry	85%	82%
Electrocardiograph	42%	27%
Other Selected Tests		
Ophthalmologist	2%	45%
Therapist	4%	36%
Proteinuria	2%	18%

Notes: These represent the five most frequently used tests. In Torzhok only, tests for AIDS (moderately expensive compared to other tests) were administered to 63% of patients in the Before group and 18% of patients in the After group.

C. Differences between Hospitals

An analysis of the direct inpatient costs by hospital found large differences between them. Direct costs were substantially higher at Torzhok than at Vyshny Volochyok before the new guidelines, and the reduction in direct costs was also larger at Torzhok (Table 10). Torzhok had strikingly larger decreases in both the number of admissions and

the average cost per admission, causing higher reductions there. Another difference between the two hospitals was the range of per-patient variation in direct costs in the Before period, with Torzhok showing a much larger spread than Vyshny Volochyok (Figure 5).

Although the analysis suffers from small sample sizes at the individual hospital level, the pattern between the hospitals is consistent across

Table 10
Comparison of Direct Costs of PIH Inpatients in the Two Hospitals (Rubles)

	Torzhok Hospital			Vyshny Volochyok Hospital		
	Before	After	Change	Before	After	Change
PIH admissions	30	2	- 93%	17	9	- 47%
Average direct cost per PIH inpatient	1,342	760	- 43%	618	617	- 0%
Total direct cost	40,272	1,520	- 96%	10,503	5,551	- 49%

the different factors contributing to cost, thereby according confidence in the results. This hospital-by-hospital analysis brings understanding about the cost savings that are likely to be achieved if the new guidelines are scaled up.

Duration and change in length of stay varied between hospitals. In Torzhok, average length of stay per patient dropped from 14.7 days Before to 7.0 After. In Vyshny Volochyok it increased from 11.8 days Before to 12.9 After. Most of the increase at Vyshny Volochyok was due to an outlier who was admitted in the After period with a moderate severity level.

In both hospitals, use of certain drugs appears to have increased in frequency, although the type of drugs differed between the two hospitals (Table 11), and the small

Figure 5
Range and Average Direct Cost per PIH Inpatient (Before Period; in Rubles)

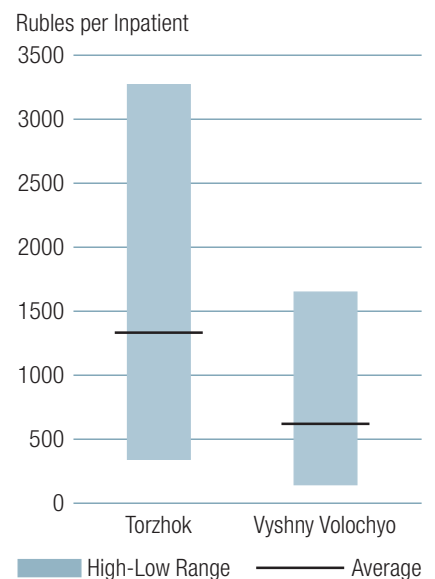


Table 11
**Percentage of PIH Cases Using Frequently Prescribed Drugs,^[1] before and after Clinical Guidelines,
by Case Severity and by Hospital**

	Torzhok ^[2]				Vyshny Volochyok ^[3]			
	Mild		Severe		Mild		Moderate	
	Before n = 19	After n = 1	Before n = 3	After n = 1	Before n = 14	After n = 5	Before n = 3	After n = 3
Glucose (40%)	100%	100%						
Methylogobrevin	100%	100%	100%	100%				
Papaverine hydrochloride	89%	100%	100%	Dis	54%	20%		
Folliculin	58%	Dis						
Oxytocin	53%	100%	100%	Dis				
Dibasol	47%	Dis	100%	Dis	54%	20%		
Novocaine			100%	Dis	69%	Dis	67%	Dis
Magnesium sulfate			100%	100%	23%	60%	100%	67%
Gendevit tablets			100%	Dis	0%	40%		
Reopolyglucine			100%	Dis	0%	40%	67%	Dis
Ringer solution			100%	100%			20%	67%
Euphyline			100%	Dis	77%	20%	67%	33%
Glucose (5%)	0%	100%						
Diazepam			100%	100%				
Buxopan	0%	100%						
Neostigmine methylsulfate	0%	100%	0%	100%				
Relanium							100%	Dis
Curantil							67%	Dis
Ascorbic acid							67%	Dis
Promedol	0%	100%						
Glucose (20%)					77%	20%	67%	33%

Notes:

1. Frequently prescribed drugs are defined as those given to 50% or more of the PIH patients in either or both the Before and After groups.
2. This analysis could not be conducted for cases with moderate PIH in Torzhok because no moderate cases were found in the After group.
3. Similarly, no severe cases were found in the Before group in Vyshny Volochyok.

"Dis" means discontinued (from use for PIH under new guidelines) or 0%.

number of cases in the After groups in each hospital makes before and after comparisons speculative. In Vyshny Volochyok, the drugs clofellini, gendevit tablets, reopolyglucine, and Ringer solution were used more frequently in the After group, mostly for mild cases, and Ringer solution for moderate cases. In Torzhok, the drugs neostigmine methylsulfate, buxopan, and promedol were used in the After group for mild cases where they had not been used in the Before group. Neostigmine methylsulfate was also used in severe cases in the After group where it had not been used in the Before group. Use of Mg SO₄ for convulsions did not change at Torzhok. Overall, Vyshny Volochyok used fewer drugs on average and achieved a more significant reduction in number and types of drugs used (50 percent reduction overall in number and type) than Torzhok.

Unit costs of inputs were generally higher at Torzhok than Vyshny Volochyok, owing generally to a higher cost of living in the Torzhok region. Torzhok prices were higher for hospital staff and food, drugs, and clinical tests. For example, the cost of meals per hospital day was 10 rubles at Torzhok compared to 6 rubles at Vyshny Volochyok. Similarly, the most frequently used test—urine analysis—cost 5 rubles at Torzhok and 4 at Vyshny Volochyok. The guideline-recommended drug Mg SO₄ cost 1.42 rubles per unit at Torzhok and 0.30 rubles at Vyshny Volochyok.

D. Differences by Case Severity

Average direct cost per inpatient varied according to the severity of PIH in the Before group, as ex-

Table 12
Average Direct Cost per PIH Inpatient in Rubles,
for Both Hospitals Combined by Case Severity

Element of Care	Before			After		
	Mild n = 33	Moderate n = 11	Severe n = 3	Mild n = 6	Moderate n = 3	Severe n = 2
Hospitalization	654	810	1,412	430	563	379
Medication	139	349	625	74	76	125
Paraclinical care (tests)	95	146	335	80	86	191
Total	888	1,294	2,372	584	726	695

pected. Table 12 shows that in the Before group, direct inpatient costs for PIH were progressively higher in more severe cases in all three elements of inpatient care. The average direct costs for mild, moderate, and severe PIH were 888; 1,294; and 2,372 rubles, respectively. The average costs for mild, moderate, and severe PIH were roughly equal in the After group (584, 726, and 695 rubles, respectively). Clearly, the average direct inpatient cost dropped substantially for all severity levels following the introduction of the new guidelines, with larger decreases in the more severe cases.

Prior to the study we thought that the new guidelines might lead to higher average per-patient costs because the new guidelines recommended admitting fewer, higher-severity PIH patients, who were expected to cost more. The data do not support this expectation. No significant cost difference exists under the new guidelines among the severity levels, and although a greater proportion of the admitted cases are more severe than before the new guidelines, costs did not increase (Table 3). These conclusions are

very tentative because of the small sample sizes.

Moderate and severe cases of PIH had larger reductions in medication cost than mild cases (Table 13). An important driver of this reduction was the decrease in the average number of different types of drugs administered per patient (Table 14). While patients with severe cases of toxemia/PIH received the largest number of different types of drugs, these patients also had the largest reduction in different types of drugs used. Significant reductions also appeared in the moderate cases.

Table 13
Average Cost of Medication
per PIH Inpatient for
Both Hospitals Combined,
by Case Severity

	Mild	Moderate	Severe
Before	139	349	625
After	74	76	125
Percentage change	- 47%	- 78%	- 80%

Reduced polypharmacy was present at all severity levels (Table 15). For example, mild PIH cases reduced usage of all five of the most frequently used drugs, from roughly one out of two patients receiving the drug Before to one out of three or one out of six receiving it After. The one exception is Mg SO₄, which increased from one out of six Before to one out of two After, reflecting compliance with the new guidelines. Similarly, among moderately severe cases, the most frequently used drugs Before were less frequently used or discontinued After. All of these findings about the polypharmacy trends are based on very small sample sizes.

VI. Assumptions and Potential Threats to Validity

Several necessary assumptions related to factors that potentially weaken the study design are discussed below:

Decline in fertility rate. If the number of pregnancies in the population served by hospitals declined between the Before and After periods (the population or the fertility rate may have dropped), the decline may have caused a drop in the number or severity of PIH cases. Changes in the fertility rate may have been due to a long-term trend, seasonality, or monthly fluctuations. In fact, the fertility rate in Russia has been declining since before the fall of the USSR, which mandated an expanded role for women outside the home (Da Vanzo et al. 2000; Zakharov et al. 1996). However, the size of this trend is very small over the study period, so its effect on our findings is probably inconsequential.

Table 14
Number of Different Types of Drugs Used to Treat PIH by Case Severity (Both Hospitals Combined)

	Mild	Moderate	Severe	Overall
Total number of different types of drugs used for all patients				
Before	55	51	33	72
After	21	15	14	32
Percentage change	- 62%	- 70%	- 42%	- 55%
Average number of different types of drugs used per patient				
Before	8	14	23	10
After	5	6	8	6
Percentage change	- 38%	- 57%	- 65%	- 40%

Table 15
Percentage of PIH Cases Using Frequently Prescribed Drugs in Before and After Groups, by Case Severity (Both Hospitals Combined)

	Mild PIH		Moderate PIH		Severe PIH	
	Before n = 32	After n = 6	Before n = 11	After n = 3	Before n = 3	After n = 2
Papaverine hydrochloride	75%	33%	82%	Dis	100%	50%
Glucose (40%)	69%	17%	73%	Dis		
Methylogobrevin	59%	17%	73%	33%	100%	50%
Dibasol	50%	17%			100%	Dis
Novocaine	50%	Dis			100%	Dis
Magnesium sulfate	16%	50%	100%	67%	100%	100%
Reopolyglucine			73%	Dis	100%	Dis
Relanium			82%	33%		
Clofellini			18%	50%		
Ringer solution			9%	67%	100%	100%
Euphyline					100%	Dis
Glucose					100%	Dis
Oxytocin					100%	50%
Diazepan					100%	Dis

Notes: Frequently prescribed drugs are defined as those given to 50% or more of the PIH patients in either or both the Before and After group. " Dis" means discontinued for PIH use under new guidelines, or 0%.

Seasonality might also be a concern because three of the six months in the Before and After periods are the same month of the year and three are not. We cannot estimate the potential magnitude of a seasonality effect, but we do not believe it had an important effect in this situation.

Decline in the incidence of toxemia/PIH. If the incidence of toxemia/PIH per pregnancy declined during the study period for some reason, this could account for at least part of the decline in admitted PIH cases. However, there is no evidence that this is the case. Given current understanding of risk factors for PIH in populations—mainly positive family history, underlying vascular disease, and first pregnancy especially among adolescent mothers—no major changes affecting these risk factors were detected. Related to this assumption is the assumption that the incidence of pregnancies that were not carried to term in this population has not changed. No specific data were found to contend this assumption.

Change in the definition of PIH. In effect, the new guidelines changed the definition of PIH. We have corrected for this by assuming that the same number of suspected PIH patients presented in the After period as presented (and were admitted) in the Before period for the cost study. This could also influence the measured health outcome indicators, because some of the women not admitted in the After period (but who would have been admitted in the Before period) may have had deliveries with negative health outcomes that were not counted in the After period. As far as we know, this was not the case, but we were unable to identify and track the care of these women.

Cost of non-included hospital services. The cost of other hospital services provided to women, specifically the cost of medical procedures, such as deliveries and C-sections, was not expected to change significantly following the implementation of the guidelines and was therefore excluded from our measures of cost. Several points support this assumption: (a) the cost of a delivery, which will occur in all admitted cases, is in large part accounted for in the cost of drugs and hospitalization already calculated in the study for all severity types, and (b) the rate of C-sections among women with PIH does not appear to have changed significantly: one case was observed in each group.

Other interventions for inpatient care. We assumed that the observed changes in PIH inpatient treatment patterns were all due to the new guidelines. We know of no other intervention that influenced PIH treatment. Further, it is plausible that the new guidelines caused the observed changes because they were implemented with a high degree of compliance.

Patient-borne costs. We measured patient-borne PIH drug costs in one hospital in both the Before and After periods and assumed that the same pattern of patient-borne costs applied in the second hospital. These costs were added to the hospital-borne drug costs to obtain total drug costs. On one hand, these patient-borne drug costs overstate the amount actually paid by the hospital. On the other hand, if there are other patient-borne costs that we have not accounted for (e.g., informal payments to providers for services and the provision of medical supplies and foods by

patients and their families), they could increase the direct costs, which might alter the reported savings.

VII. Conclusion and Discussion

When the new guidelines for PIH care were introduced in the pilot hospitals in Tver, health outcomes improved and hospital costs decreased. This result seems almost too good to be true. However, the logic of the new guidelines supports these results. The new guidelines focus inpatient resources on fewer and more severe cases of PIH, treat those cases more aggressively, and rely on systematic outpatient care for identifying and triaging the PIH cases that need close attention.

Three factors contributed most to the reduction in inpatient costs: reduction in the number of hospitalized cases, reduction in length of hospitalizations, and more rational use of drugs. While the relatively small number of cases analyzed in the study makes it difficult to draw firm conclusions, the findings strongly suggest that using the new guidelines is associated with significant economic benefits.

In the short run, further analysis of the effect of using clinical guidelines on costs at the outpatient level may be valuable. Preliminary results suggest that outpatient costs have been rationalized following the implementation of the guidelines, probably resulting in a small decrease in costs. However, more information on the patterns of care for PIH outpatients is needed to determine the nature and magnitude of the effects of the guidelines on

care. Still, findings are encouraging and consistent with expected results of using the new guidelines.

More data and analysis are needed to confidently project the potential economic benefit of the new guidelines to the oblast level or on the long-term costs. Differences in the existing and potential patterns of treatment in different hospitals

should be considered and better understood to make projections realistic. Also, the benefits obtained from improved health outcomes for women with PIH and their newborns remain to be further studied and quantified. For example, additional information on the impact of the new guidelines on reduced drug interactions from reduced polypharmacy, on potentially reduced sequelae,

and on future social and economic benefits would help position this intervention in relation to other proposed programs. Analysis of factors that influence care practices, and by extension the extent of use or non-use of guidelines, would also help to strengthen future analyses (e.g., factors related to the characteristics of patients, providers, or hospitals).

Endnotes

- ¹ The Scope of Work included the following tasks: (a) Reach consensus on concepts and terminology in quality of health care and publish a glossary, (b) Train a team of senior Russian health care professionals in quality improvement, (c) Develop two demonstration projects that introduce quality improvement methods in the Russian Federation (one in primary care in Tula Oblast; the other in maternal and child health in Tver Oblast), (d) Develop indicators of quality to measure improvements in quality of care, (e) Publish a Russian language quality improvement guide, and (f) Disseminate success stories of quality improvement in Russia.
- ² PIH is a complication of pregnancy characterized by elevated blood pressure and sometimes by protein in the urine and edema after the 20th week of gestation. Its causes are not well understood. During pregnancy, PIH can progress to pre-eclampsia, characterized by headaches, vomiting, impaired vision, abdominal pain, and further increases in blood pressure, urine protein, and edema. In the most severe cases, pre-eclampsia progresses to eclampsia, characterized by convulsions. If untreated, eclampsia can result in death from brain hemorrhage or from failure of the heart, liver, or kidney. Pre-eclampsia is associated with increased perinatal deaths and increased newborn complications, especially if untreated. Risk factors for PIH include first pregnancy especially among adolescents, overweight, family history, and underlying vascular diseases including diabetes.
- ³ "Toxemia" is the diagnostic classification generally used in Russia in place of PIH. Toxemia typically includes all PIH cases plus others. In this paper, the term "toxemia/PIH" refers to women classified as having toxemia prior to the new guidelines and women classified as having PIH after the guidelines were implemented.
- ⁴ These references present examples of how this integrated methodology was applied in different clinical areas, including PIH, by the QA Project. The six steps in the EBCG development methodology are: (a) study the existing system of care for the improvement under consideration, (b) document existing clinical practices and content at each step, (c) review evidence-based literature on content of care, (d) update clinical content of care, (e) enhance system capability to accommodate updated content, and (f) review and update indicators to fit updated content.
- ⁵ The cost study data were not collected for as long as the "Health Outcomes" data described in Section III.
- ⁶ At the time of this study, the exchange rate for \$1.00 U.S. ranged from 21.5 to 28.6 rubles.
- ⁷ There are two other groups of women who delivered during the study periods: those who were hospitalized with PIH but did not receive outpatient care of any sort, and those who were not hospitalized with PIH and did not receive any outpatient care. A much larger proportion of admitted women in the After group did not receive outpatient care of any sort (5 of 11 or 45 percent) than in the Before group (9 of 47 or 19 percent). We do not know the reason for this.
- ⁸ Including access to antenatal care services.
- ⁹ At each hospital the estimated cost per inpatient day is assumed to be constant throughout the study, and therefore the change in total direct cost between the Before and After groups is proportional to the change in the number of PIH inpatient days (Total cost = inpatient days x cost per day). However, the average cost per day is not the same in the two hospitals, and therefore the total cost in both hospitals combined did not drop by the same proportion as the number of days.
- ¹⁰ Looking at only Vyshny Volochyok patients, total inpatient drug costs borne by patients represent about 56 percent of total inpatient drug costs in the Before group and about 30 percent of inpatient drug costs in the After group.

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