Reform of tuberculosis control and DOTS within Russian public health systems: an ecological study

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Objectives: To investigate the association between clinical need and hospital bed supply and utilization in Russia; and, to investigate these associations in areas where traditional Russian tuberculosis health care systems exist and where the directly observed therapy–short course (DOTS) strategy has been implemented. Design: Ecological study using 2002 routine data. Main outcome measures: Hospital bed utilization and hospital admissions for patients with tuberculosis in regions that adhere to the traditional Russian method of managing tuberculosis and those where the DOTS strategy has been implemented. Results: The ratio of beds per newly notified case was 0.86. The mean duration of hospital stay per admission was 86 days for non-DOTS regions and 90 days for regions where the DOTS strategy had been implemented. The number of admissions in each region correlated closely with the number of newly registered cases and hospital beds were, on average, occupied for 325 days. In the regions where the DOTS strategy had been implemented bed occupancy was 324 days. Conclusions: Under the Russian tuberculosis control system, hospital utilization is predominantly determined by supply-side factors, namely the number of tuberculosis dedicated hospital beds, and this system extends across all regions. Implementation of the DOTS strategy in Russia has not led to fundamental structural changes in tuberculosis control systems.

Methods

Tuberculosis dispensaries and statistical offices in each of the Russian Federation’s 68 administrative provinces and 21 federal republics routinely collect aggregated data on the diagnosis and health management of TB cases by means of standard Ministry of Health reporting forms and submit it annually to the Russian Ministry of Health. Data used in this study were reported by 79 of 89 regions in 2002 drawing on 2001 data.

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ince 1995, demonstration projects implementing the World Health Organization (WHO) approved TB control strategy, ‘directly observed therapy–short course’ (DOTS), have been initiated with support from international and bilateral agencies, such as the WHO, World Bank, the UK Government’s Department for International Development (DFID), and United States’ Centres for Disease Control and Prevention.¹ The DOTS strategy has five components: sustained political commitment; access to quality-assured TB sputum microscopy; standardized short-course chemotherapy to all cases of TB under proper case-management conditions; uninterrupted supply of quality-assured drugs; and recording and reporting system enabling outcome assessment. New regulations have recently been adopted by the Russian government to support implementation of standardized international practices in TB treatment and control in line with the DOTS strategy.² ³ However, most recent figures suggest that by 2003 only 25% of the Russian population lived in regions where they had access to the DOTS strategy, compared with an average of 79% for all the 22 high-burden countries. Moreover, the proportion of patients with TB managed under the DOTS strategy in Russia remains low, at 8.8% in 2003.⁴

Traditionally in Russia, case management has been based on individualized treatment and the requirement to achieve lung cavity closure before treatment is deemed complete; it requires hospitalization of new cases who can expect to undergo lengthy and repeated hospitalizations.¹ ⁵

The DOTS strategy, in contrast, promotes standardized treatment regimens, with the completion of a defined period of treatment, and sputum conversion as the cardinal measures of success.⁵ The strategy favours minimal hospital stays, advocating the use of ambulatory care where possible.⁵ ⁶ Economic evaluations have shown that the DOTS strategy is cost-effective in the Russian context, and Russian experts have highlighted the efficiency of ambulatory care.⁶ However, the traditional model of care has prevailed and TB patients in Russia continue to experience lengthy hospital stays.¹ ⁹ ¹⁰

The implementation of DOTS should, thus, ideally, go hand in hand with a reduction in in-patient supply and utilization, reflecting the diminished need for institutional care associated with the new model. To date, no studies have explored the extent to which this has happened or indeed whether there is any relationship between need, supply, and utilization in the Russian TB system. This study explores, across all 89 Russian administrative regions, the relationship between clinical need for TB care (as measured by new notifications of TB), supply of hospital beds, and two indicators of provision (number of bed-days and hospital admissions) in dedicated TB in-patient facilities. We also look at the relation between average hospital admissions per bed and length of hospitalization. We compare those regions that adhere to the traditional Russian method of managing TB and those where the WHO DOTS strategy has been implemented with external international support [Tomsk, Kemerovo, Leningrad (region of St Petersburg), Mari el Republic, Murmansk, Vladimir, Novgorod and Orel].

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We used ‘newly notified cases’ as proxy for annual clinical need for TB care in the region. The term ‘newly notified cases’ refers to TB patients who have never had treatment for TB and who were diagnosed in Ministry of Health institutions either by bacteriological examination or chest X-ray with clinical signs. The data refer to civilian TB cases only. (Other TB patients, e.g. prisoners, soldiers, and immigrants are treated outside Ministry of Health institutions).

The definitions of indicators of regional hospital bed capacity and TB health care provision are as follows:

- **TB beds:** Total number of beds in all TB health care facilities or beds in other facilities dedicated to TB care only.
- **Bed days:** Number of days each TB dedicated bed was occupied.
- **Hospital admissions:** Number of admissions to TB dedicated hospital bed per year.
- **Bed days per case ratio:** TB beds/Newly notified cases.
- **Mean duration of hospital stay:** Bed days/Hospital admissions.
- **Bed occupancy:** Bed days/TB beds.
- **Throughput:** Hospital admissions/TB beds.

We used ‘number of hospital beds’ as an estimate of regional bed capacity, and ‘bed days’ and ‘hospital admissions’ as two indicators of in-patient health care provision. For each administrative region we calculated two more indicators of health care provision: ‘mean duration of hospital stay’ and ‘mean bed occupancy’, and one indicator that determines the relation between beds and annual hospital admissions (‘Throughput’).

To compare regions using the international DOTS strategy for TB control with those regions with traditional TB treatment and control, we assigned all regions where DOTS was implemented before 2001. Inclusion criteria were: Total implementation with at least one international donor, 100% population coverage in 2001, Letter of implementation signed between 1995 and 1999. Eight regions met the inclusion criteria with a total population of 10.6 million (Tomsk, Kemerovo, Leningrad, Mari El, Murmansk, Vladimir, Novgorod, and Orel).

Our analysis comprises descriptive statistics. In order to determine associations between clinical need, bed capacity, and indicators of health care provision, we estimated Pearson’s correlation (and its two-tailed significance) to quantify the association between newly notified cases and (i) admissions and (ii) bed days; and between bed-days in in-patient facilities and available beds; and between throughput of patients per bed and average length of stay, in all cases using Oblasts and the unit of analysis. Statistical analysis was performed using the Statistical Package for the Social Sciences, version 14.

### Results

#### New tuberculosis cases and bed capacity

In 2001, ~120 000 new cases of TB were notified in Russia. This included ~95 000 cases in the civilian sector and 25 000 cases in prison and other health sectors such as the military. The TB case notification rate during 2001 was 88.2 per 100 000 population overall and 65.6 per 100 000 in the civilian population. The rate in the civilian sector varied across the 89 administrative regions of Russia, from 30.9 to 280 per 100 000 population.

In 2001, there were 74 787 beds in the Ministry of health facilities dedicated to TB care of adults. An additional 7240 beds were dedicated to care of children with TB. The ratio of beds per newly notified case was, consequently, 0.86 ranging across the administrative regions from 0.34 to 2.3 beds per new case notified.

#### Utilization and response to need

Overall, the mean duration of hospital stay per admission for adults with TB in 2001 was 86 days, ranging across the regions from 53 to 132 days. Among those regions where the DOTS strategy had been implemented in the period 1994–1999 the figure was the same at 86 days (table 1).

TB-dedicated hospital beds were, on average, occupied for 325 days (89% of the year) in 2001, ranging from 214 to 360 days across the regions, that is, from 59 to 99% of the year. In the regions where the DOTS strategy had been implemented bed occupancy was 313 days (86% of the year) (figure 1). To describe the utilization of in-patient care in more detail we calculated the throughput of TB-dedicated hospital beds (the number of patients admitted per bed per year). The association between throughput and length of stay (for the 43 regions from which length of stay data were available) is shown in figure 2. Of note, two outlying regions had, on average, only one admission per hospital bed in 2001, so that the mean duration of stay approached almost 12 months.

We found a correlation between the number of newly notified cases and hospital admissions (Pearson coefficient, r = 0.84) (figure 3). Where the number of notifications was >1500 cases, the dispersion around the regression line was greater. The relationship was the same in regions with and without DOTS.

The number of bed-days also correlated closely with new notifications of TB (r = 0.91) and again there was greater dispersion around the regression line in those regions with >1500 cases. There was no difference in regions that had implemented DOTS compared with those that had not.

We found a very strong correlation between bed-days and number of hospital beds (r = 0.99) (figure 4).

| Table 1 | Indicators of bed capacity and health care provision for TB in the Russian Federation, 2001 (all 89 administrative regions, 81 regions without DOTS, and 8 internationally supported DOTS pilot regions) |
|-----------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
|                                                | Russian Federation (89 administrative regions) | 81 non-DOTS regions | 8 DOTS pilot regions |
|                                                | Average (range) | Median (regions) | Average | Average |
| TB beds per newly notified case (ratio, beds for whole year) | 0.90 (0.34–2.3) | 0.85 | 0.91 | 0.86 |
| Bed occupancy (days per year, adults) | 324 (214–360) | 329 | 325 | 315 |
| Duration of hospital stay (days per admission, adults) | 86 (53–132) | 86 | 86 | 86 |
| Hospital admissions per outpatient visit | 15 | 15 | 23 |

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**TB reform in Russia**

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Discussion

Before reviewing the implications of this analysis it is necessary to consider the quality of data. Compared with other high-burden countries, Russia is considered to have a fairly comprehensive system of tuberculosis surveillance. There is an extensive network of tuberculosis facilities, although it should also be noted that laboratory facilities are often antiquated. Nonetheless, Russian data on tuberculosis notifications are widely viewed as credible. The data on bed utilization are potentially more problematic, given the financial incentive to report beds as filled. However, in our experience with detailed regional studies of both tuberculosis and obstetrics, we have found no evidence of major inaccuracies. Instead, what seems to happen is that clinical practice changes. In the case of tuberculosis there is probably over-diagnosis because of a dependence upon radiological diagnosis.11 In obstetrics, the decline in birth rate has been compensated for by a marked increase in both admission rate and length of stay of pregnant women who are labelled as having ill-defined ‘complications’.12 Consequently, while we cannot exclude common reporting errors, we have no reason to believe that there is systematic bias that would undermine our findings.

We show that while the in-patient capacity to manage patients with TB in Russian regions correlates closely with the number of new cases, the high level of utilization of that capacity has not...
been reduced to any noticeable extent by the introduction of DOTS in some regions. This provides a further example of Roemer’s law: ‘If there is an assured payment system, it seems that almost any additional hospital beds provided will tend to be used, up to a ceiling not yet determined.’\textsuperscript{13} It seems likely that ensuring high bed occupancy through repeat admissions or lengthy hospitalizations (because of institutional financial remuneration mechanisms) is a more profound driver of the health care system response than clinical need.\textsuperscript{5,14} We show that, although length of stay clusters around 90 days (the length of time for admission of new patients recommended by Federal norms)\textsuperscript{15–17} there is considerable variation in order to ensure high bed occupancy. Previously we have shown this to be the case for Samara Oblast—the findings presented here show that this is a generalizable feature across Russia.\textsuperscript{5,14,18–20}

The DOTS strategy does not exist in isolation. For it to achieve its goals and be sustainable many aspects of the public health system, including institutional, regulatory and financial elements, must work effectively. In Russia, hospitals across most of the country are funded according to line item budgeting inherited from the Soviet Semashko model where health funds are allocated according to inputs such as the number of hospital beds, the average length of stay, and numbers of doctors. Similarly, hospital funding for TB in most regions is based on the existing number of beds and bed occupancy. This preserves existing structures and provides a strong incentive for providers to maintain existing beds and hospitalize TB patients. Moreover, these funding mechanisms reward the proliferation of infrastructure and inputs rather than improving efficiency and outcomes. In a small number of regions, we have previously explored the reasons for the extensive use of hospital care for TB

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**Figure 3** Bed-days in all tuberculosis-dedicated in-patient facilities and newly notified cases across 89 administrative regions in Russia, 2001 ($r = 0.84, P < 0.0001$)

**Figure 4** Bed-days and number of beds for tuberculosis in all tuberculosis-dedicated in-patient facilities across 89 administrative regions in Russia, 2001 ($r = 0.99, P < 0.0001$)
patients in Russia and have shown that provider payment systems profoundly influence admission patterns by encouraging lengthy and repeated hospitalizations, as TB hospitals receive a line item budget from regional administrations that includes the number of beds and number of patients treated. There is, hence, a strong incentive to retain the number of beds as a reduction would lead to a lower income.\textsuperscript{14} This system also promotes unnecessary interventions (such as surgical interventions), and the absence of alternative provision means that TB hospitals function as social care institutions as well as medical facilities, with increased admissions in cold months as a protection against harsh climatic conditions.\textsuperscript{6,18,20} These factors make it difficult to adapt the provision of care to changing needs and potentially pose a systemic barrier to the wider use of DOTS.

Given these strong financial and regulatory incentives it is not surprising, therefore, that in Russia hospital stays are often lengthy and hospital utilization lacks responsiveness to need. This is in contrast to practices elsewhere internationally. For example, average hospitalization periods of 14–38 days have been reported for TB from the UK, Italy, and Egypt.\textsuperscript{6,21,22} In countries where TB services are well developed and where the DOTS strategy has been effectively implemented hospital-based expenditure is significantly less than that for out-of-hospital care.

Considerable financial support (through domestic, bilateral, and multilateral agencies) has been expended in recent years in implementing the DOTS strategy in Russia. We show, however, that despite this investment and associated changes to clinical practice, recording and reporting systems, and laboratory services, structural changes to health service provision in in-patient facilities have not occurred in pilot sites across Russia. Bed capacity, duration of hospital stay, admissions to TB-dedicated beds, and bed occupancy remain high and do not differ significantly from regions where the DOTS strategy was not been implemented. In countries where health system reform occurs in conjunction with DOTS implementation, a substantial decline in utilization of in-patient services has been realized. Though having a markedly different health care system, in Malawi, for instance, implementation of the DOTS strategy concurrent with a decentralization of in-patient treatment resulted in a decrease in average length of hospital stay for TB treatment from 58 days in 1997 to 16 days in 1998, and bed occupancy dropped by 38% in the same period.\textsuperscript{23}

It is clear that implementation of the DOTS strategy in Russia has not led to fundamental structural changes in TB control systems. Instead, it appears that DOTS programmes have been implemented in parallel to, or as an adjunct to, existing health systems.

In Russia, supply-side factors and provider payment systems may be more potent drivers of the health system response than clinical need.\textsuperscript{14} It is perhaps not surprising, therefore, that implementation of the DOTS strategy in pilot sites up to 2002 has not resulted in an increase in the responsiveness of in-patient structures and systems to changing clinical need.

Treatment costs for TB in Russia are relatively high, at $3472 per case, some 16 times greater than the median cost in other high-burden countries.\textsuperscript{24} Most of these costs are related to in-patient care costs.\textsuperscript{4,19} This over-emphasis on in-patient care means that the cost-effectiveness of the Russian TB control system is low compared with alternative national TB control programmes. WHO suggests that high costs associated with the TB dedicated hospital network in Russia is a substantial burden on Russia’s national TB control budget, a budget currently facing an estimated $40–50 million shortfall.\textsuperscript{6} High hospitalization levels are also likely to result in nosocomial spread of TB to health care staff and possibly other patients.\textsuperscript{25}

Our study may be limited in a number of ways in addition to data issues referred to above. For example, ecological bias remains a possibility. In addition, despite our attempts to address this issue, the implementation of DOTS in regions may have been unequal and yet not be reflected in official data. Finally, our investigation shares the limitation of all observational research in that although we show associations, inferences about causation are speculative.

Our findings have important policy implications for TB control systems in Russia and other countries of the former Soviet Union, where similar public health systems exist and where TB hospitals should not only the costs of extensive periods of clinical care but also a substantial burden of non-clinical social support. Introducing the DOTS strategy and improving the efficiency with which existing resources are used will require reform of health system norms and regulations related to planning, financing, training, and clinical and social care. Given the rigidity of public health structures, these changes may take time. National and international agencies would do well to support health system reform over the medium to long term.

The DOTS strategy is a disease-specific strategy that aims to support tuberculosis control, but does not address inefficiencies of the health care system. Yet for the public health benefits of the DOTS strategy to accrue and efficiencies to be realized and sustained, what is needed is more than simply the adoption of the principles of DOTS (which have been realized through national regulations in 2003) and a vertical implementation of control strategies. Structural reforms to prevailing health systems and social care financing mechanisms are also needed.

Key points

- We have shown previously that structural factors hinder the delivery of efficient care to TB patients in Samara Oblast, a region of Russia.
- Research presented here shows that these findings are probably generalizable across the Russian Federation.
- Under the Russian tuberculosis control system, hospital utilization is predominantly determined by supply-side factors.
- Implementation of the DOTS strategy in Russia has not led to fundamental structural changes in tuberculosis control systems.
- For the DOTS strategy to be sustainable in the Russian Federation, reforms of institutional, regulatory, and financial systems are needed.

References


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