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## How has the management of acute coronary syndrome changed in the Russian Federation during the last 10 years?

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### ABSTRACT

**Methods:** We report trends and patterns of percutaneous cardiovascular interventions (PCI) by region for 2005–2009, with more detailed data on management of myocardial infarctions in 2009–2013, relating them to regional economic development and changes in mortality from myocardial infarction.

**Results:** PCIs per 100,000 population increased from 8.7 in 2005–71.3 in 2013, with considerable regional variation. In 2013 the highest rates were in the wealthiest regions, although not in some remote regions dependent on oil and mineral extraction. Between 2009 and 2013 rates of thrombolysis in those with acute myocardial infarctions potentially eligible for treatment remained broadly similar at about 28% but rates of primary revascularisation with stenting rose rapidly, from 6.5% to 23.7%. In-hospital mortality from myocardial infarction since 2009 has declined most in regions achieving highest rates of primary revascularisation.

**Conclusions:** The sustained investment in advanced cardiovascular technology has been associated with substantial increases in revascularisation in some but not all regions. However, rates overall remain far behind those in Western Europe. Further research is in progress to understand the reasons for these variations and the barriers to further expansion of services.

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### 1. Introduction

Cardiovascular disease mortality has been declining in nearly all high income countries for many decades [1]. These declines, beginning as early as the 1960s in some countries, have reflect both reduction in risk factors and improved primary and, most recently, secondary prevention [2]. Today in well-resourced settings, somebody who has a heart attack is more likely to survive than in the past, due to widely available medical interventions, including timely non-invasive percutaneous cardiovascular interventions (PCI) such as balloon angioplasty [3,4], in which an atherosclerotic occlusion of the coronary artery is opened through inflation of a small balloon. This was introduced in the 1980s [5] and, initially, was mainly an elective procedure for people with symptomatic

coronary artery disease [6], alongside coronary artery bypass grafting (CABG) which also became common at that time [7]. The extension of PCI to insert a stent, to keep the artery from closing up again, started to be introduced into routine practice in the 1990s. Today it is commonly used as the primary intervention in acute myocardial infarction. There is now good evidence that these primary reperfusion interventions result in better outcomes than thrombolysis [8] and, in many countries, there is now a switch from thrombolysis to PCI for ST-elevation myocardial infarctions (STEMI), although progress is variable [9,10]. Yet while these minimally invasive procedures are now relatively straightforward to perform, they still require a substantial initial investment in equipment and training of expert staff.

Access to new treatments for ischemic heart disease is high on the agenda in the Russian Federation, where mortality from cardiovascular disease has been falling since 2005/6 although it remains among the highest in the world. In a speech on September 5, 2005, Russian President Vladimir Putin announced four national priority projects, including one focussed on improving population health. A council to implement the projects was established,

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initially headed by Putin himself and subsequently by Prime Minister Dmitry Medvedev, involving enhanced cooperation between federal, regional and local governments, non-governmental organisations, and research institutes. The health project sought to decrease the burden of disease, improve accessibility to high-quality health care, develop a prevention-oriented health care system, increase the role of primary and ambulatory care, and increase the provision of advanced medical technology. In 2008, a specific goal to reduce mortality from cardiovascular diseases was added. Increased funding was made available to improve salaries of health professionals and purchase new equipment, with federal expenditure increasing from 87.9 billion roubles in 2006–160.2 billion roubles in 2010. Initially it was planned that 80% of funds would go to primary care and disease prevention, with the 20% going to advanced medical technology. However, during the course of implementation, this shifted to a 55%/45% split. [11]

The project did much to address the long-term underinvestment in advanced medical technology in Russia. The first evaluation of the implementation of the project, in 2007, reported that 680,000 health workers had received increased salaries, 13,500 primary care physicians had undergone retraining, waiting times had reduced, and over 5500 health facilities had been re-equipped.

Its implementation has coincided with the decline in mortality from cardiovascular disease in Russia noted above. However, the role that the various federal initiatives may have played in this decline is uncertain. One study using registry data from regions acquiring new percutaneous cardiovascular intervention (PCI) centres has reported a decline in-hospital mortality [12] but otherwise there is little information on the results of the investment in advanced specialist equipment across the whole country.

In this paper, we use the available data to assess, to the extent possible, how far the investment in specialist cardiological equipment has resulted in increased numbers of PCIs (a measure of process). In addition we investigate whether at a regional level there is an association between expansion in PCI activity and changes in-hospital mortality from acute myocardial infarction among MI patients admitted to hospital in the Russian Federation.

## 2. Methods

Data on hospital activity and outcomes were obtained from the Federal Research Institute for Health Organization and Informatics of Ministry of Health of the Russian Federation. It is responsible for collating data from all Russian public hospitals, each of which is required to make regular statistical returns that are assembled initially at the regional level. These data are supplied to the Institute in the form of tabular data. Hospitals in Russia are organised in a territorial basis, at regional and federal level, with increasing levels of specialisation. In 2008, only 124 of the 6545 hospitals in Russia were privately owned and these hospitals are also required to make statistical returns. Thus, we believe that the data provide a relatively comprehensive picture of activity across the country.

We were provided with information collected on State Statistical Form 14 “Data on hospital functioning” for the years 2005–2013. This included the total number of invasive cardiovascular procedures, both Percutaneous Transluminal Coronary Angioplasty (henceforth referred to simply as PCI) and coronary artery bypass grafting (CABG). For the years 2009–2013 more detailed information was available, comprising numbers of patients with myocardial infarction (patients whose diagnosis was coded as ICD-10 I21) admitted within 12 or 24 h of symptom onset and who received thrombolysis or PCI with stenting. We present results according to two levels of geographic aggregation as defined in 2013: the 8 federal districts or the 83 constituent regional admin-

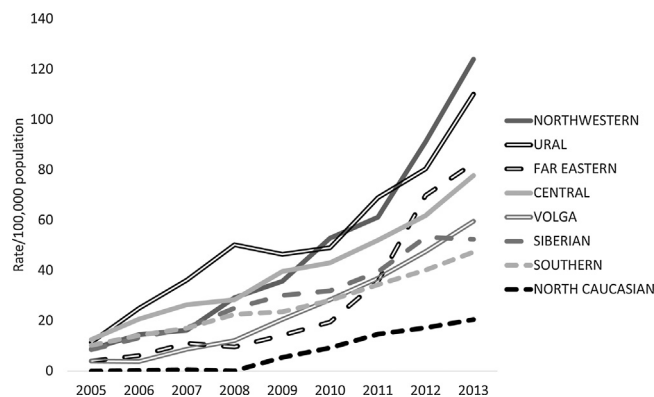


Fig. 1. Trends in PCI/100,000 population by Russian federal district 2005–2013.

istrative regions, generally known as oblasts (Box). None of these data are broken down by age and sex.

Given the limitations of these data we adopted a pragmatic definition whereby patients deemed potentially eligible for either of these interventions were those admitted within 12 h of symptom onset, although of course this will include a variable proportion who are ineligible because of delay or contra-indications. Data on population and gross regional product of the regions of the Russian Federation were obtained from the State Statistical Committee, Rosstat.

We analysed time trends in rates of PCI per 100,000 population for the period 2005–13. We also analysed trends in the proportion of myocardial infarctions subject to PCI with stenting within 12 h of onset for the period 2009–13. We also investigated whether this progress was associated with the economic wealth of the region. Finally, we sought to determine if there was any association between greater use of primary revascularisation for myocardial infarction within 12 h of onset and in-hospital mortality. As noted, we only had data on these acute interventions from 2009, although we know that, outside a few large cities such as Moscow, it was very uncommon prior to this. Thus, it was not possible to correlate changes in acute stenting and mortality at regional level over this entire period. As a pragmatic alternative, recognising that rates were almost universally close to zero in 2005, we divided the regions into 4 categories, based on the rate of primary revascularisation in 2013 (following exclusion of those admitting fewer than 500 patients/year within 12 h of symptom onset). We then regressed in-hospital mortality by year between 2005 and 2013 in each of these regional groupings and modelled the impact on mortality from the resulting equations.

Data analyses were undertaken using SPSS. ArcGIS was used to visualise geographic variation in rates.

## 3. Results

The number and rates per 100,000 population of myocardial infarctions admitted to hospital within 24 h of onset and both PCI and coronary artery bypass grafting (not further considered) by year in the Russian Federation as a whole is shown in Table 1, for each year between 2005 and 2013.

The number of PCIs has risen markedly, but at different rates per head of population across the country. Fig. 1 shows the trends in procedures in the eight federal districts. All had rates below 15/100,000 in 2005 but, by 2013, the north-western federal district, which covers the area from St Petersburg to the Urals, had achieved a rate of over 120/100,000, while in the North Caucasus it was only 20/100,000, an over a 6-fold variation.

A more detailed picture of geographic variation in the rate of PCI procedures is provided in Fig. 2, which maps rates at the level of

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