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Distributed Data-Driven Platform for Urgent Decision Making in Cardiological Ambulance Control

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Abstract. This paper presents ongoing research aimed at developing a data-driven platform for clinical decision support systems (DSSs) that require integration and processing of various data sources within a single solution. Resource management is developed within a framework of an urgent computing approach to address changing requirements defined by the incoming flow of patients with urgent diseases. This work presents DSS for support of ambulance and emergency medical service management for patients with acute coronary syndrome (ACS) as a working example with integration distributed streaming data sources as well as data storages (containing electrocardiography (ECG) data, electronic medical records (EMR), real-time monitoring of medical facilities, and schedules of hospitals within a network). This DSS has been developed in collaboration with the Federal Almazov North-West Medical Research Centre in Saint Petersburg.

Keywords. data-driven approach, decision support systems, data fusion, information fusion, acute coronary syndrome, ambulance, emergency medical service, data streaming, apache storm

1. Introduction

According to a World Health Organization report [1], cardiovascular diseases are the major cause of death in the world. Many types, such as acute coronary syndrome (ACS) or stroke, require treatment within several hours, and delays significantly decrease the probability of a favorable outcome [2]. Usually, patients who suffer such acute diseases are served by emergency medical services: visited and transferred by ambulance, have a surgery or intensive therapy at the hospital. In the prehospital setting, patient evaluation, triage (care strategy and hospitalization pathway selection), and early treatment are essential for positive outcomes. Considering differences in equipment, a load of hospitals and ambulances, transportation difficulties in urban traffic, and possible variations in the urgency for a particular patient and multiple ambulance services, the issue of coordination and decision support for such services becomes especially important.

In this paper, we present an ongoing project aimed at developing a clinical decision support system (DSS) for managing emergency medical services in cases of acute cardiac disease using an ACS patient as a working example. The goal of the developed DSS will be centralized coordination of ambulance cars and emergency medical services in a set of hospitals with special facilities for cardiological healthcare to respond to ACS treatment requirements. The DSS has been developed in cooperation with the Federal Almazov North-West Medical Research Centre (FANWMRC)¹ in Saint Petersburg.

Today, development of DSS for ambulance dispatching and routing is a widely covered area (see e.g., [3–5]) with a strong theoretical background in field operational research and management science [6]. Nevertheless, practical implementation of DSS for ambulance control for the case considered here requires the management of many specific issues. First, all the mentioned issues and specific aspects of particular disease treatment should be taken into account and resolved within the considered scenarios. Second, proper implementation of DSS requires integration of diverse data and information sources (sensors, public data services, and electronic medical records) with variations in formats, access policies, protocols, and so on. As a result, when developing a DSS, one

¹ <http://www.almazovcentre.ru/?lang=en>

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