I INTRODUCTION

Telemedicine (TM) services proved its value and efficacy and have been worldwide deployed at various rate and extent, mainly depending on the economic strength of a country, especially its telecommunication and Informatic infrastructure.

Although the economy in FR Yugoslavia experienced permanent decay during ‘90s, including those domains that represent substrate for TM introduction, Yugoslav telecommunications benefited significant development (e.g. Telecom Serbia Ltd. since 1997 invested more than $215 million [1], rapid spread of the GSM network, with over 1 million subscribers, covering 70% of territory and 90% of population (2000), considerable percentage of PCs and Internet users).

Seemingly exhausted by strains during ‘90s the Yugoslav Health Care System is vital. General Practice (Primary health care) acts through 1849 organizational units (1998) including 208 Health Care Centers (HCC), accomplishing 40.185.000 visits per year, 54 General Hospitals, 19 Spec. Hospitals, 6 Clinics (out of Clinical Hospital Centers (CHC) and Clinical Centers (CC)) etc. Highly complex and differentiated health care is provided by 3 CC and 7 CHC, having in total 60.000 beds with 1.222.786 cured patients (1997), with the turnover of 2 billion DEM. There are 134.990 employees, out of which 72.2% are health personnel, with 30.190 physicians (of which 68.1% are specialists and 15.6% general practitioners), giving 467 inhabitants per one physician (1998 - compare to 533 in 1986). There are over 3000 private medical firms [3] as well.

Although unfavorable for general introduction strategy such a situation still was favorable for almost state-of-the-art attempts, which inevitably were sporadic and with limited reach, sometimes spontaneous (e.g. Military Academy of Medicine, Oncology Institute in S. Kamenica etc.[8]). Last couple years positive attitude toward TM turned into Federal government’s initiative of TM introduction that resulted in General project of Telemedicine in FR Yugoslavia (promoted in Jan. 2001) [5].

However, there will be a considerable time gap to the beginning of extensive TM deployment, influenced by various factors, but that process must not be delayed or hesitated.

There we find the room for an idea of a telemedical system (TMS), in many aspects different from existing ones (e.g. [6,7]). It is essentially patient-oriented and would use available resources, demanding minimal investments or slight upgrade of existing communication infrastructure, to provide effective primary health care (distant) services. For the beginning, instead of whole system implementation, it is much better to follow the spot strategy.

II THE SYSTEM PURPOSE

The main goal is to increase the effectiveness of patient treatment procedure in primary health care, i.e. at the HCC level, in order to reduce job time wastage of employed patients and medical personnel, to reduce transportation expenses etc.

The chief expected effects cover the population of so-called routine patients, which treatment entirely remains within the HCC, with mostly one or possibly a couple contacts (distant interviews/visits) to the physician, which are employed and busy and showed their attitude to busy time by subscribing to GSM. That does not mean the access to TMS is attained only over the GSM, but also includes PSTN and Internet. Therefore, the proposed system is discriminative in respect to the rest of patient population, which remain on conventional visit-examination procedure in the HCC, including other categories of patients (children, pupils, students etc.) that are covered by special health services.

III SYSTEM PLANNING

The functional structure and design of the TMS must be closely related to “disease” input, which it should respond to. Available statistical data are used to determine starting parameters of the system.

Primary health care service, with its own specialist service, takes 35.7% of all visits. For our purposes the ratio First/Again visit is particularly important and during 1990’s the ratio was close about (between 46-47%)

Another indicator may be the number of physicians in primary service - 3.636 (35.0%), comprising 56.7% general practitioners and 43.4% specialists (with 6.751 (65.0%) of other health personnel) [3]. These parameters serve to estimate the percentage of patients/service users of the TMS, particularly the ratio phys./spec., reflecting the profile of patient structure.

The analysis of morbidity in ex-hospital care (Table 1) significantly refines the estimation based on former data. In General Practice, with 42.9% of all registered disease cases, the five most frequent groups of disease, conditions and injuries include

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<tr>
<td>1. Diseases of respiratory system</td>
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<td>2. D. of circulatory system</td>
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<tr>
<td>3. D. of genito-urinary system</td>
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Relying on these data, it can be estimated the percentage of routine cases, first visit close cases, portion of forwarded ones to specialist after first, second, etc. visit. These parameters support the concept of such a TMS and serve as a background for its dimensioning.

Another very important parameter for system design is the average duration of visit which is not easy to measure, even with specific questionnaire.

IV FUNCTIONAL STRUCTURE OF THE SYSTEM
The urban area of city Belgrade is considered as the best substrate, having the best available features for high system performance. The percentage of GSM customers and Internet users (over home and/or office PCs) is prominently higher than the FRY average [2]. There are several HCCs in Belgrade, several laboratories and many pharmacies.

Let us consider a HCC in Belgrade with corresponding area which residents belong to it over their home addresses. But here we distinguish an usual HCC and HCC with specialist health care.

By its mobile phone the person that needs to visit a doctor makes a call to the reception office (RO) in the HCC, to which administratively belongs. Because of the profile of expected user the RO does not need to cover the whole period 0-24, but e.g. 08-22. There are several operators working in it - specialists of general practice. The number of operators depends of a prior estimation of incoming traffic intensity and is subject to change during system exploitation. Reception system in the HCC performs automatic call identification, including verification of the user in respect to phone number and home address, in order to prevent possible misuse. In case of detected non-affiliation the system sends machine voice message to the user and the call is not proceeded to the operator-doctor. The use of Internet has its own advantages, while the access over the PSTN may cause unnecessary traveling, waiting and wasting all the day at the health care institution. Call verification is already unnecessary traveling, waiting and wasting all the day at the health care institution. Call verification is already

It is important to point out that the (employed) user/patient can address the RO at any time, according to its own schedule or available moment, without according to the user/patient availability, the doctor examination/visit, with no emergency, the visit will be arranged with “second-line” doctor. The administration is the same as in a1).

Apart from such distant service the HCC performs conventional medical service, oriented to old patients, retired, unemployed etc. Health care for youth, school children and other specific patient categories is performed outside this system.

Reliability of the first call diagnosis/classification is very important and inevitably influenced by the lack of visual contact physician-patient, which may cause, although in rare cases, neglecting of (a) significant symptom(s) that could cause complications till the arranged interview time. Such a possibility of wrong “verdict” can be easily compensated by careful estimation and lowering the threshold to step a2) and/or a3).

In regard to system bandwidth and engaged channels one should consider (enhanced) SMS service for the beginning interview, where the user would respond to the RO questions by short (one- or two word) answers, in order to prevent inconveniences imposed by slow keypad of mobile phone. Such a communication highly accelerates administration of user file in the RO.

It is important to point out that the (employed) user/patient can address the RO at any time, according to its own schedule or available moment, without unnecessary traveling, waiting and wasting all the day at the health care institution. Call verification is already mentioned, misuse and user anonymity is easily solved by one-use personal code.

b1) As the next step after a2), at appointed time, the user/patient makes a call by which second, more thorough interview begins, while the “second-line” doctor automatically gets on his monitor patient data from HCC data-base. He gives advises and suggests or prescribes medicines for the therapy. Conventional, free-market medicines patient gets in a pharmacy (when he wants). Otherwise, for prescription medicines the doctor sends over the HCC server a search-request to the pharmacies administratively belonging to the HCC area, receives the answer and sends to the patient the SMS message that contains address of the pharmacy and purchase code. The patient simply memorizes the message in its mobile phone, which will be showed to the pharmacist when buying the medicine, according to patient schedule. The patient shows the code, picks up the medicine(s), pharmacist cancels the purchase on his computer which cannot be completed without detailed insight, another voice interview is arranged with “second-line” doctor, according to the user/patient availability, the doctor schedule, and user condition. The administration is the same as in a1). The a1) step is intended to restrain the whole system engagement by handling “light” users/patients and forwarding much smaller percentage of “heavier” users to second stage.

a3) if the symptoms indicate the need for direct examination/visit, with no emergency, the visit will be arranged with “second-line” doctor. The administration is the same as in a1).

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**Table**

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<th>D. of musculo-skeletal system</th>
<th>D. of digestive system</th>
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<tr>
<td>4</td>
<td>6.2%</td>
<td>5.2%</td>
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automatically sends the data to the HCC data-base. (Here we do not consider the issue of medicine availability in pharmacies, since it is not expected that the distant solved/cured cases demand very specific ones.) If necessary, the doctor defines the next interview, either to control patient state or to continue the prescription.

VI CONCLUSION

The main purpose of such a TM system is to handle a considerable percentage of routine cases, which do not necessarily demand direct contact with the physician. By such a distant curing all unnecessary spending of job time of employed users/patients for visiting medical institutions is avoided, and wastage of energy, money as well. Each step of the procedure significantly reduces the fraction of patient initial input, so the small portion remains for conventional health care procedure, which, on the contrary, should pass all beginning patients.

The system enables users/patients to interleave their schedules with others very effectively, which is essential effect of broad information connectivity. Therefore, such a procedure makes the working process of medical personnel more coherent, less stressful, with far lower fluctuation of people in medical institutions and amortization rate of medical resources/ facilities, reduction of personnel etc.

Collateral effects include: mobile operators would benefit from its introduction and spreading, other related areas are influenced by positive effects, enhanced education of population, raise of technical/medical culture etc. The first part of the paper shows how the system is designed over estimations from rough statistical data, including difficulty in measuring the average duration of the visit. On the contrary, this TM system automatically measures and extracts all necessary statistical parameters and can even become self-adaptive in order to match incoming traffic.

LITERATURE


Abstract - The paper describes in detail the functional structure of a proposed telemedical system within a Health Care Center, intended to enhance efficacy of primary health care, especially in beginning stage of routine cases treatment procedure. The system mainly
relays on existing GSM network and Internet implying low investments and minimal additional equipment. In that we see a promising pattern of introducing some (basic) aspects of distant health care. Such a system would provide significant effects including improved performance of health care system, considerable reduction of busy time wastage for employed patients and medicine personnel as well, savings in transport, lower amortization rate of medical equipment and facilities etc. Among side effects stands enhanced telemedicine education of population that would favour subsequent introduction of more complex telemedicine services. Spot introducing strategy is aimed at a global system that would cover the whole city area.