Hospital-Transport Cooperation: Medical Treatment Scheduling Method Cooperated with Public Transport and Rural Hospital

TSUYOSHI TAKAYAMA[1], AKIHIRO KANAYA[1], MIKIHITO ISHIKI[2], YOSHITOSHI MURATA[1]
KEN SHIDA[1], TETSUO IKEDA[3] and NOBUYOSHI SATOH[1]
[1] Faculty of Software and Information Science
Iwate Prefectural University
152-52, Sugo, Takizawa, Iwate020-0193
JAPAN

http://www.iwate-pu.ac.jp/
[2] Director
Iwate Prefectural Takata Hospital
34, Nakazeki, Kesen, Rikuzen-Takata, Iwate029-2204
JAPAN
http://www.pref.iwate.jp/~hp9001/iphs/iph090/iph090.htm
[3] School of Administration and Informatics
University of Shizuoka
52-1, Yada, Suruga, Shizuoka, Shizuoka422-8526
JAPAN
http://www.u-shizuoka-ken.ac.jp/

Abstract: - This paper proposes 'Hospital-Transport Cooperation' method which smoothly connects medical treatment in a hospital and public transport, as a medical treatment scheduling method for a rural hospital. In a rural hospital, it is difficult to carry out the same medical treatment reservation system as in an urban hospital because of each circumstance on hospital, patient, and public transport. Therefore in this paper, taking into account circumstances of these three sections, we propose a method which sets an inherent prior time zone for each area or direction along not frequent public transport. We also develop a scheduler and simulator required to realize the proposed method, and evaluate its effectiveness. An active director of a hospital has evaluated it useful.

Key-Words: - Applications, intelligent system, medical information system, scheduling, database, Web-based system.

1 Introduction

In this paper, based on the reference [1], we classify all hospitals into the following two categories: 'urban type hospital' and 'rural type hospital'. Table 1 shows its classification standard.

The urban type hospital has lots of populations around it, and the frequency of public transport is high. On the other hand, the rural type one has few peripheral populations, and the frequency of public transport is low. Hereafter, we abbreviate the urban type hospital to 'urban type', and the rural type hospital to 'rural type'. These two boundaries are not strict. Since they are rather relative, it happens to be difficult to determine which category a hospital belongs to near the boundaries.

Table 1 Definition of urban type hospital and rural one

	urban type	rural type
peripheral populations	much	few
frequency of public transport	high	low

The target of our discussion in this paper is the rural type, especially medical treatment for an outpatient. In the rural type, it has high possibility not to introduce a reservation system into medical

treatment for an outpatient. It is because the rural type usually does not determine a physician in charge of each outpatient and efficiently distributes the entire load by full-time and part-time doctors. In here, a full-time doctor works almost every day, on the other hand, a part-time doctor works in limited day and in low frequency. As a result, medical treatments are carried out in arrival order of outpatients.

Most of outpatients in the rural type are older people. Unfortunately, it has high possibility to depend on his/her family drive for a round trip to a hospital. In a rural area, not a few people are engaged in agriculture. They get up very early in the morning and start to work. It means that some older outpatients are sent to the rural type by their family drive very early in the morning. Its arrival time to the rural type is much earlier than the start time of medical treatment.

We can consider a more flexible reservation system. It is to determine only the name of an outpatient and its time without determining a physician in charge. However, it is not always easy to come to the rural type and to go back home fitting to a reservation time. We can point out the following two reasons:

- The frequency of public transport is low.
- It is not easy for the family to sacrifice his/her work in many times and to send the older outpatient to a rural type, fitting to a reservation time.

From the above-mentioned situations, medical treatment for outpatients in rural type has the following three problems:

Problem 1 (waiting time): The waiting time from the arrival to medical treatment is very long.

Problem 2(arrival time): Some outpatients have to come to the rural type much earlier than the start time of medical treatment in order to obtain better arrival order or in order to depend on the family drive.

Problem 3(stay time): The stay time in the rural type is very long.

In this paper, as our solution, we propose 'Hospital-Transport cooperation' method which smoothly connects medical treatment in the rural type and not frequent public transport.

2 Approach in This Paper

2.1 Basic idea

In this paper, we investigate our discussion under the following five conditions:

(1) Medical treatment for an outpatient is opened from AM9:00 to 12:00 in weekday.
(2) An outpatient comes from either of five areas(A-E) around a rural type(Fig. 1).
(3) Public transport comes to the hospital from four directions of east, west, south, and north. Only public transport of east direction passes two areas D and E in (2). Other three public transport passes each one area in (2)(Fig. 1).
(4) The hospital has two booths for medical treatment. We introduce prior time zone into one of the two booths.
(5) We set the length of a prior time zone to one hour per one area or one direction.

Based on the above-mentioned (1)-(5), we allocate a single prior time zone per two days to each area or direction. We try to satisfy the following three conditions at most: (a) waiting time is short, (b) arrival time to the hospital is late, and (c) stay time is short, if an outpatient uses a prior time zone for his/her area or direction and gets on the specified public transport service(bus/train) on a round trip.

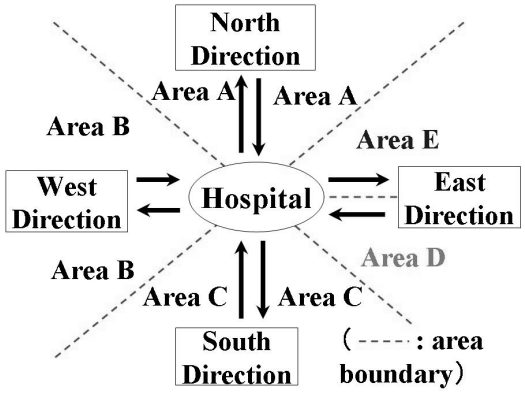

Fig. 1 Hospital and its peripheral cituation.

2.2 Scheduler

We develop a scheduler which realizes the basic idea in the subsection 2.1 and generates efficient allocation plans(Fig. 2).

We beforehand register a timetable of public transport to its database and cause to be updated. Function required to this scheduler is to output efficient allocation plans of prior time zone per each area or direction from the registered timetable. We prepare two allocation policies: one minimizes average stay

time to users of prior time zone and the other minimizes its variance. Since the number of the possible allocation plan is not so many, we evaluate all allocation plans and determine which plan is the most approapriate for each policy.

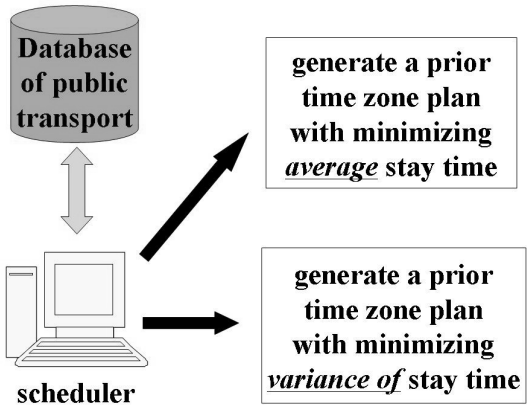

Fig. 2 Scheduler which proposes prior time zone plan.

2.3 Simulator

We develop a simulator which enables us to evaluate its validity and effectiveness in the case that we adopt an allocation plan proposed by the scheduler.

We set the input variable to 'the number of outpatient per each area in two days' and 'the ratio which outpatients uses a prior time zone'. On the other hand, the output variables are the following four ones: 'average waiting time', 'average arrival time to the hospital', 'average stay time', and 'the ratio which outpatient misses the specified public transport'. We formulate each output variable using the input variables. The concrete value of each output variable is derived if we provide the input values.

3 Pilot System and Evaluation

Fig. 3 shows an example of output page by the scheduler. In this case, we adopt the policy which minimizes average stay time.

Fig. 4 shows an example of output page by the simulator. We fix the number of outpatients for each five area to actually observed value in a rural type, and moves the ratio which outpatients use a prior time zone. According to its evaluation, we have obtained the following two knowledge:

(i) The more the ratio which outpatients use a prior time zone increases, the more we have obtained the merits that outpatients may arrive at late in the morning and waiting time is reduced.

(ii) On the other hand, the more the ratio which outpatients use a prior time zone increases, the more we have obtained the demerits that average stay time becomes long. It is because prior time zone users are enforced to stay in the hospital until the specified public return transport starts from there.

Subjective evaluation by an active director of a rural type is as follows. ``Pilot system is useful. Robustness for timetable revision is effective. At first, we investigate to adopt a prior time zone in one or two areas.''

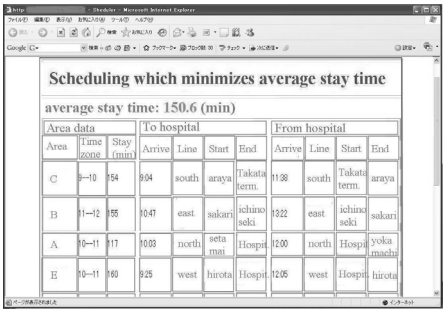

Fig. 3 An example of output page by the scheduler.

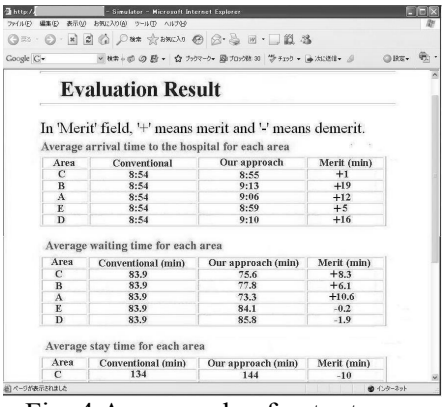

Fig. 4 An example of output page by the simulator.

4 Related Researches

There exist some related researches which medical treatment and public transport cooperate.

One of them is to put a bus location system in the waiting room of a hospital[2]. Outpatients who have finished their medical treatment can go to the bus stop with confirming approach of a return bus. However,

this method is useful only in the urban type through which a public transport runs frequently. Even if we introduce it into the rural type, it is not useful.

Another research is 'dial-a-ride' method[3]. It is not method only for a hospital. It is a typical method for a rural area, and it causes a bus to run along a dynamically determined root based on trigger calls by some customers. However, this method is not useful in our cituations, neither. It is because patients are so many that waiting time is problem. It has possibility to be sent a trigger call per an outpatient who has finished his/her medical treatment. Too many customers are not adequate for the dial-a-ride method. A bus company becomes difficult to balance its income and outgoing.

From these observations, we have proposed another cooperation method between a hospital and a public transport, except for 'bus location system' or 'dial-a-ride'. Our method reduces an outpatient's load and promotes to use a public transport.

5 Conclusion

In this paper, we have proposed 'Hospital-Transport cooperation' method which smoothly connects medical treatment and not frequent public transport, as a medical treatment scheduling method for a rural hospital. We have also developed a scheduler and simulator required to realize the proposed method. An active director of a rural hospital has evaluated our method useful.

As future research directions, we can point out the follwing: (a) more intelligent scheduling taking into account the outpatient ratio per each area or direction , (b) modification of the proposed method based on the discussion with a public transport company.

References:

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