SCHEDULING PATIENTS BASED ON PROVIDER'S AVAILABILITY

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ABSTRACT

We present the approach taken to schedule patient arrivals in the simulation of specialty clinics and their associated Ambulatory Surgery unit at the Orlando VA Medical Center (OVAMC), Orlando, Florida, USA. In these clinics, patients arrive by appointment. A primary care provider (PCP) electronically requests an appointment (consult) with a specialist and a reviewer decides whether and when the consult takes place. Requests for new patient appointments arrive electronically 24-7. The decision depends on the provider's availability. A clerk schedules the patients. Once a scheduling slot is found, a message is sent to the patient who then shows up at the scheduled time. If a specialist is not available within a reasonable time horizon (the goal is within two weeks), the request may be transferred to a community provider on a fee basis. We discuss issues associated to slot sizing and overbooking policy. The measures of performance include percent of requests scheduled within a week and percent of patients seen by the provider within two weeks.

Keywords: appointment scheduling, outpatient scheduling, object-oriented simulation, decision support system

1. INTRODUCTION

We presented elsewhere (Bozorgi and Sepúlveda 2011) the simulation of the specialty clinics and their associated ambulatory surgery unit at OVAMC. That simulation has been successfully used to streamline operations, including monitoring patient flow, setting priorities, supervising the assignment of resources, scheduling people, sequencing procedures, surgery scheduling and how the electronic waiting lists are kept.

A preliminary analysis of the initial simulation runs indicates that, once they arrive at the OVAMC for a scheduled appointment, patients can expect to be treated within a reasonable time. The problem seems to be in getting to the OVAMC in the first place; e.g., there are scheduling-related problems. For example, the EWL (Electronic Waiting list) printed on June 1 shows a few active consults (mostly "routine" cases) pending for over a year. The clinic wants at least 98% of all new requests approved and scheduled (or rejected) within a week of the time the request is received. The clinic wants to schedule at least 90% of all new patients within two weeks of the first request. The percent of consults scheduled within a week of request and the percent of cases completed (patient seen by specialist) within two weeks of the consult request clearly do not meet expectations.

For the daily operations simulation, the main measures of performance (MOPs) are patient time [hours] in the system (from arrival to the clinic until the patient leaves the clinic) and resource utilization. For the revised problem (performance over an extended period of time), the main MOP is the time elapsed [days] from consult request by the PCP until the patient is seen by the specialist. We test different scheduling ideas that will improve compliance with VA goals as well as reduce the average time to treatment and the maximum length of time (beyond the initially provider-specified date) a patient is in the EWL.

2. PATIENT SCHEDULING

This work focuses on the approach taken to schedule patient arrivals in the simulation of the outpatient specialty clinics and their associated ambulatory surgery clinic. The simulation focuses on the scheduling process: A primary care provider (PCP) electronically requests an appointment (consult) with a specialist; requests arrive electronically; they are reviewed by a specialist who decides whether to take the case, who will take it, and its urgency. The request is then handed to a clerk for actual contacting the patient and scheduling. Once a scheduling slot is found, a delayed message is sent to the patient who then appears in the simulation at the scheduled time and date. Thus, in our situation, patients do not arrive at random.

The scheduling decision depends on the provider's availability and willingness to overbook patients, if necessary. If the specialist is not available within a reasonable time horizon (the goal is within a month), the request may be transferred to a community provider on a fee basis.

2.1. Consults

The clinic wants at least 98% of all new requests approved and scheduled (or canceled) within a week of the time the request is received. The clinic wants to schedule at least 90% of all new patients within two weeks of the request.

Requests for new patient ("consult") appointments arrive electronically 24-7. If no reviewer is available, the requests are automatically placed in an electronic waiting list (EWL).

Process maps (see Figure 1) were created through comprehensive and iterative interviews and unit/team staff feedback sessions. These results were validated through follow-up workshops and interactive meetings. Bottlenecks and inefficiencies were identified and presented to the unit staff.

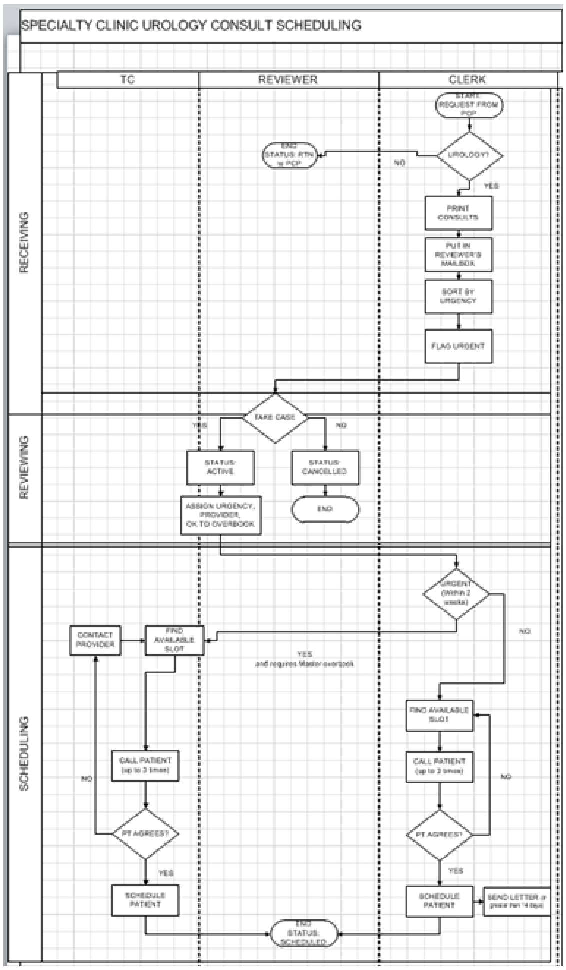


Figure 1 – Urology Consult Scheduling Process Map

Each specialty clinic (ENT, Eye Clinic, General Surgery, GYN, Orthopedics, Podiatry, Urology) has one or more (depending on request volume) specialists that review the requests to determine if a new request will be accepted, who will provide the service, the urgency of the request and, for cases that need to be seen urgently, whether overbooking the provider is allowed. Given the same urgency, new requests are processed FIFO. A large majority of requests are accepted. Rejected requests are counted and send back to the originating PCP with an explanation. New patients are assigned to clinic providers on a round-robin basis.

Table 1 presents the daily workload of scheduling clerks by clinic. The second column ("ApptMade/day") reflects the total number of appointments processed daily (includes consults and follow-up appointments). The third column ("consults/day") specifies the number of daily consults. The last column presents the ratio of follow-up appointments per consult. In addition to scheduling patients, clerks check patients in and out of the clinics. This is reflected in the "Check-in/day" column.

Table 1 Scheduling clerk workload, Specialty Clinics

Desk	ApptMade/day	Consults/day	Check-in/day	clerks	Follow-up/ Consult
AmbSurg	56.2	12.1	32.8	1	3.6
ENT	39.9	3.4	36.6	1	10.8
GenSurg, ENT	53.4	7.0	36.0	2	6.6
GYN	44.0	6.2	30.9	1	6.1
OPHTH	53.7	24.0	34.4	3	1.2
ORTHO_POD	44.4	15.1	31.2	2	1.9
Urology	27.5	7.4	22.9	1	2.7
Total per day	319.2	75.1	225.0	11	3.2

After the reviewer decides what needs to be done, the request is returned to the clerk for scheduling. Urgent requests (patient needs to be seen within two weeks) are scheduled by the Team Coordinator (TC). If necessary, these requests may be overbooked. Non urgent request are scheduled by the clinic's clerk and they are not overbooked.

2.2. Consult Scheduling

Depending on the clinic, scheduling slots may be 15, 20 or 30-minutes. Consults are requests for patients who have not been seen at the clinic within the last 24 months (or ever). Consults require longer time (two slots) with the provider so the provider can get familiar with the case. The assigned time should be sufficient to cover direct contact with patient and the necessary time to record the encounter's details. If a provider has not finished recording and another patient is waiting for a scheduled appointment, the provider must finish the recording at a later time the same day.

The clerk (or TC) must first find two contiguous slots available for the assigned provider during the window established by the reviewer. If no slots are available, clerk (or TC) must inform the provider who may change the window or allow over-booking the time slots.

The next step is contacting the patient to find out his/her preferred time within the window established by the reviewer. Three phone calls are mandated (if needed, they take place at different times of the day, in different days). Once the patient agrees on a time, the consult request is scheduled. If the patient proposes an alternate time, the clerk may need to consult the provider. If the patient cannot be located, the consult is scheduled and a letter with the appointment time is mailed to the patient.

The consult scheduling process ends when the consult is scheduled. In the simulation, a message is sent to the patient to show up at the appointed time.

2.3. Ambulatory Surgery Consults

If a patient is determined to need surgery, a request for a new surgery consult is generated by the surgeon who provides an estimated time for the surgery depending on the procedure and the patient's health condition. Surgery requests are processed through a specialized scheduler (Surgery Coordinator) who finds a time where the surgeon and an operating room are available within one of the weekly time windows assigned to the surgeon's specialty, books the OR, schedules a pre-op visit for the patient, and makes sure that everything is ready and available the date of surgery. The Surgery Coordinator handles all requests for surgery from all specialty clinics. Once a surgery slot has been selected, the Surgery Coordinator asks the clinic's clerk to contact the patient to schedule the pre-op visit and the surgery.

2.4. Follow-up visits

After a consult, the provider may decide that a return visit if warranted, usually after the patient gets some exams done. All patient return visits ("follow-up"), as well as lab and imaging exams, are scheduled by the clinic's clerk. Follow-up visits are scheduled for one-slot.

Follow-up visits that need to take place within three months are scheduled at patient check-out time. Those with a larger time horizon are placed on a different electronic list, called the "Recall list." The patient is asked at check-out for a preferred time and the actual schedule is mailed via regular mail about three weeks before the appointment.

3. THE SCHEDULING PROCESS

For the surgical specialty clinics in the study, the ratio of consults to follow-up visits is 1 to 3.2 (on the average each new patient returns 3.2 times, i.e., about once every three months, for additional care related to the same consult). For this VA center as a whole, this ratio is closer to 1:6, which may reflect the incidence of chronic illnesses.

From a scheduling perspective, the main difference between consults and follow-ups is that urgent consults are handled by the scheduling supervisors ("team coordinators") while non-urgent consults and follow-up visits are scheduled by the unit's clerk(s).

3.1. Clerks

In addition to the clerical processing of new consults, clerks are responsible for scheduling consults and follow-up visits, as well as for checking patients in and out as they come for their appointments. Checking-in entails going over patient's data (address, phone, etc.) and scanning insurance cards. Checking-out involves getting from the patient the desired date and time for the follow-up appointment, scheduling the appointment (if any) and scheduling labs and imaging exams (if any).

4. THE SIMULATION

Finally, we discuss the object-oriented simulation model developed to analyze the described as-is scheduling process situation and its potential alternatives.

We used Flexsim Healthcare as our simulation platform. Flexsim HC is an object-oriented language that provides a library of ready-made software "objects" that have a real-life physical counterpart.

A software object has structure (features) described by attributes (properties) and behaviors (operations). For example, a nurse "knows" what to do when told to transport a patient to a given location, including where to return the wheel chair after use. This helps to create models that "make sense."

Flexsim HC's library (see Figure 2) includes objects for patient arrival, queuing and processing as well as staff and equipment groups. There are also non-human objects ("items") which we used to model electronic requests for appointments.

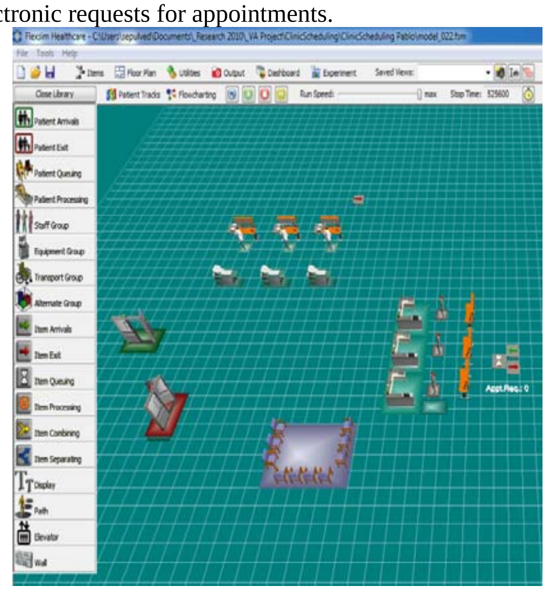
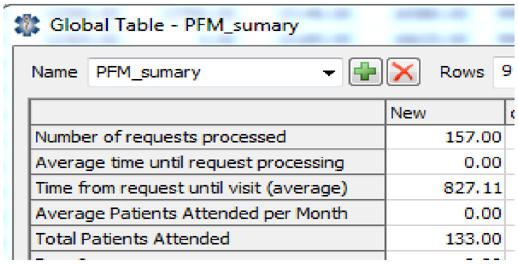


Figure 2 - Flexsim HC library of objects

4.1. Simulation details

When the model opens, two global tables are displayed: one is a Summary table; the other is the Appointments table (there is one for each physician).

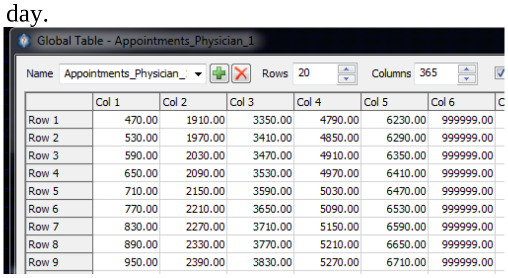
The Summary table (Figure 3) has 5 rows: Number of requests processed; Average time until request processing; Average time from request until visit; Average patients attended per month; and Total patients attended.



	New
Number of requests processed	157.00
Average time until request processing	0.00
Time from request until visit (average)	827.11
Average Patients Attended per Month	0.00
Total Patients Attended	133.00

Figure 3 - Summary Table

The Appointment table (Figure 4) has, for each provider, 365 columns (one per day for a full year) and 20 rows. Each row represents an appointment block. There are up to 20 appointment blocks per physician each day.



	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Row 1	470.00	1910.00	3350.00	4790.00	6230.00	999999.00
Row 2	530.00	1970.00	3410.00	4850.00	6290.00	999999.00
Row 3	590.00	2030.00	3470.00	4910.00	6350.00	999999.00
Row 4	650.00	2090.00	3530.00	4970.00	6410.00	999999.00
Row 5	710.00	2150.00	3590.00	5030.00	6470.00	999999.00
Row 6	770.00	2210.00	3650.00	5090.00	6530.00	999999.00
Row 7	830.00	2270.00	3710.00	5150.00	6590.00	999999.00
Row 8	890.00	2330.00	3770.00	5210.00	6650.00	999999.00
Row 9	950.00	2390.00	3830.00	5270.00	6710.00	999999.00

Figure 4 - Appointments Table

Consult requests ("items") are generated in ItemArrivals1. Items join the ItemQueuing1 queue. The number of items in queue statistics is displayed.

On exiting the queue, items go to Appoint Processing1 where the appointment is processed by a reviewer. The appointment processing time is the time it takes the reviewer to determine if the request is valid.

The request is then queued to a clerk who spends some time finding an open slot for the desired provider. After hours and Saturdays and Sundays are off (block value = 99999) (see Figure 4). If the appointment block is empty (value=0), a patient can be scheduled in that block (two continuous slots are needed for consults; one slot for follow-up visits).

After finding a candidate slot, the clerk must call the patient. When a patient is scheduled, the corresponding block in the Dr.'s appointments table displays the appointment time (in minutes since time 0, e.g., midnight of day 1. For example 470 means 0750 of day 1; 1910 means 0750 of day 2; etc. (See Figure 4)

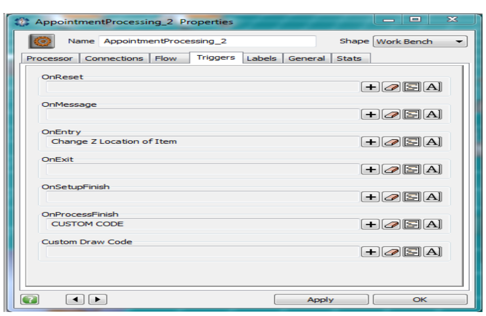


Figure 5 - Message triggering

After the appointment processing ("OnProcessFinish") (Figure 5), a delayed message is triggered ("OnProcessFinish" CUSTOM CODE). Parameters transferred are (Figure 6): the node where message is sent (Arrival1; this is where the patient will show up in the simulation), the length of the delay (delay_msg), the current object (person requesting the consult: current), the Dr # (rr_variable), and if new or established patient (itemtype), and the current time. ["senddelayedmessage(Arrival1,delay_msg,current,rr_variable,getitemtype(item),time());"]

Figure 6 - Message sending

The delayed message will arrive at "Arrival1" (the entrance node to the simulation) at the scheduled time and will then create the patient.

4.2. Scenarios

Scenarios deal with varying number of resources (clerks, providers), varying slot length or number of slots assigned to a visit, and different hours of operations for the facility, individual specialty clinics or selected personnel.

4.3. Results

The simulation model accomplishes the following:

1. Keeps track of the number of unprocessed (electronic) requests and the average time elapsed until a schedule slot is assigned to a patient-provider pair.
2. Interacts with an appointments relational database of all scheduled appointments and surgeries, as well as scheduled vacations and other non-available times, on a rolling one-year horizon.
3. Once a visit is scheduled, the simulation model makes the patient show up for the appointment at the scheduled time.
4. Determines the average elapsed time from the initial request until the first visit takes place.
5. Determines the average number of repeat visits.
6. Determines the average elapsed time from initial request until the case is completed.
7. Estimates the average time after the clinic's closing ("overtime") the provider must remain in the office finishing the daily dictations.
8. Determines the average throughput (cases completed per month).
9. Determines average backlogs per month

10. Percent requests waiting more than one week for scheduling
11. Percent new requests waiting more than one month for first encounter with a provider.

Note that, except for walk-in cases, patients do NOT arrive at random (electronic requests do). Scheduled patients arrive at their scheduled appointment time (unless they are no-shows, a property that depends on the type of appointment and the specialty involved). Returning patients are scheduled must see their originally assigned provider.

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