Analysis and Monitoring of Patient Logistics in the Cardiology Outpatient Clinic

WA Dijk[1], R Hoekema[2], M van der Vlugt[2], WRM Dassen[3], ET van der Velde[4], NHJJ van der Putten[5], CAM Hooijschuur[1], JP Busman[1]

[1]University Medical Center Groningen, Groningen, The Netherlands
[2]University Medical Center Nijmegen, Nijmegen, The Netherlands
[3]Maastricht University Medical Center, Maastricht, The Netherlands
[4]Leiden University Medical Center, Leiden, The Netherlands
[5]Erasmus Medical Center, Rotterdam, The Netherlands

Abstract

This paper describes the AMOC project which aims at the improvement of patient throughput in the outpatient clinics. Indicators describing the workflow were extracted and serve as a base for a so called continuous improvement model. As pro actively monitoring the workflow turned out to be the best tool to optimize the throughput, a computer system was developed to present in a "dashboard" like manner the state of the indicators.

1. Introduction

The aging of the general population and high prevalence of cardiovascular diseases have resulted in saturation of the capacity of outpatient clinics and functional test laboratories. This frequently results in an intolerable long time period between the onset of complaints and the final diagnoses and the start of treatment.

Furthermore the Dutch government decided to publish outpatient clinic waiting times as of September 2008 in order to give the potential patients an extra decision tool for choosing which hospital he or she wants to visit, next to other information like quality of care, the size of the parking lot, etc. As healthcare in the Netherlands, like in many other western countries, becomes increasingly market driven, these other facets next to pure quality of care start playing decisive roles in the patients choosing process which hospital to visit.

This problem is regularly experienced in the departments of Cardiology of the Dutch university medical centers. Therefore a project called AMOC (Analysis and Monitoring the Outpatient Clinic) was started, guided by the ICIN, the Interuniversity Cardiology Institute of the Netherlands, to evaluate the situation and to develop tools to improve the patient throughput while guarding the quality of patient care.

2. Methods

The AMOC project consists of 4 main phases:

1. Analysis of the present situation: in order to understand the waiting time in the cardiology outpatient clinics as it is, an analysis of factors influencing the waiting times is made.
2. Comparison of the results of the participating centers: detailed production figures of the outpatient clinics of the participating centers were collected and a comparison was made between them, on waiting time, number of new/control patients
3. Development of a continuous improvement model [1,2]. Based on the analysis of the present situation and then comparison between the participating centers, a continuous improvement model was designed, that was subsequently implemented. The model describes all processes that influence patient throughput (such as that of referral, registration, planning, visit, documentation), as well as the resources it depends upon and possible intervention points.
4. Development of a computer system for monitoring and enhancing the patient throughput: the continuous improvement model is used as a basis for this computer system. It allows for online monitoring the production figures for each center, finding the weak spots in the outpatient process (for example, intolerably long waiting times for certain appointments) and suggesting improvements in the outpatient process (for example, temporarily enlarging the echo-capacity by using additional evening-appointments)

3. Results

3.1. Analysis of the present situation

Exact information of time instances describing the workflow was not readily available in most of the clinics. This is due to the fact that different, not connected, systems play a role in the logistic process. When a patients case is presented to the physician in charge to decide which trajectory has to be followed, frequently the necessary information is not available, resulting in a delay. Once the decision is made, appointments can be made for additional functional tests that have to be performed in order to narrow down the diagnosis and treatment window. Depending on the work diagnosis, the patient has to undergo one or more functional tests. A patient possibly suffering from rhythm disturbances will generally speaking be subject to an ambulatory monitoring test rather than a VO_2 max test while a patient indicated for heart failure will have an echocardiogram and exercise tolerance test to support the diagnosis.

Minimizing the patients travel burden functional tests are tried to be planned in one day. These attempts to combine appointments frequently cause for an extra delay. Especially echocardiography tests generate waiting times due to the felt increased importance of this test and too slow expanding capacity. The test results except for the Holter analysis are normally available right after the test ends and at the doctor's disposal. When a patient has to revisit the outpatient clinic the described process more or less repeats itself.

Other influencing factors are the so-called "no show" visits indicating that a patient or doctor did not show up at an appointment.

Also students are trained to become a cardiologist in our university hospital departments. Part of the training is of course the diagnostic process in the outpatient clinic. Intuitively one would expect that in general trainees apply for more functional tests than senior cardiologists, just to be on the safe side, resulting in extra pressure on the functional test laboratory.

3.2. Comparison of the results of the participating centers

In table 1 an indication of the size of the 5 participating outpatient clinics is displayed (minimum, average and maximum) over the year 2007. As the functional test laboratories also service other departments, the total number of tests performed and the number of tests ordered by the outpatient clinics is shown. The number of visits to the outpatient clinics and the functional test laboratories (electrocardiography (ECG), total as well as for the Cardiology Outpatient Clinic (COC) echocardiography (ECHO), ambulatory monitoring (Holter), exercise tolerance test (ETT) and VO_2max) show similar patterns across the participating clinics.

Table 1. The number of visits to the outpatient clinics and the functional test laboratories.

	Min	Avg	Max
Outpatient clinic	11500	16900	22000
ECG	16000	35000	77000
(COC)	12000	14500	16000
ECHO	6800	8900	10250
(COC)	4100	5300	7500
Holter	1350	2650	7200
(COC)	800	1050	2000
ETT	550	1950	3100
(COC)	350	1300	2250
VO_2 max	350	500	600
(COC)	300	400	450

Table 2 shows the relation between the total number of consults and the number of new patients in 2007. Comparing the different clinics reveals large differences in the ratio of the total number of visits and the amount of new patients. The lower 2 rows display the number of so called "no shows" and the ratio between this number and the total number of visits at the outpatient clinics. Also these statistics differ significantly between the clinics.

Table 2. The relation between the total number of consults and the number of new patients in 2007.

Outpatient clinic	Min	Avg	Max
Total visits	11500	16900	22000
New patients	2950	4350	5500
Ratio (%)	20.0	23.5	26.5
No show	550	750	850
No show (%)	3.9	4.5	5.0

Table 3 is identical to table 2 except that in table 3 only the consults by the trainees are shown. No significant differences between the trainees and the senior cardiologists were found per clinic.

Table 3. The relation between the total number of consults and the number of new patients by cardiology trainees in 2007.

Outpatient clinic	Min	Avg	Max
Total visits	2650	3550	4800
New patients	450	750	1150
Ratio (%)	17	21	24

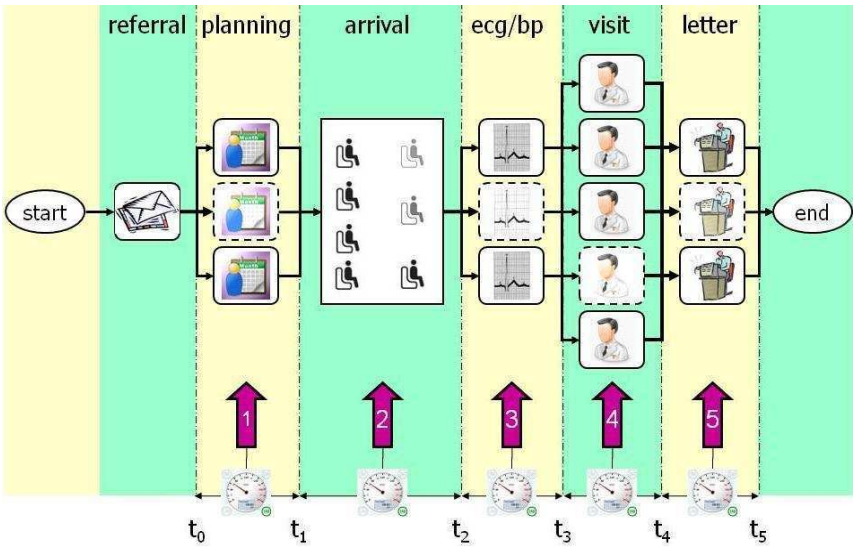

Figure 1. Part of the continuous improvement model

As the appointments for follow-up visits occur in a repetitive manner, their waiting times do not represent the intended indicator. Therefore only the waiting times for new patients were taken into account. Table 4 shows the minimum, average and maximum waiting time in days for the functional test laboratories of one of the participating centers.

An additional column displays the total amount of the "no shows" for each test. Besides the gaps in the agendas, no shows cause huge amounts of extra meaningless work!

Table 4. Example of minimum, average and maximum waiting times in days for different functional tests and the number the "no shows" in 2007 for one of the participating centers.

Test	min	Avg	Max	no show	no show(%)
Echo	0	41	192	316	6.0
Holter	0	26	105	118	5.9
ETT	0	34	132	99	4.4
VO_2max	1	54	186	23	5.8

Table 5. Initial functional tests for some diagnostic groups advised to be performed.

Diagnosis	ECG	ECHO	Holter	ETT	VO_2max
Heart failure	X	X		X	X
Rhythm	X		X	X	
Ischemia	X			X	
Congenital	X	X	X		X

As mentioned earlier the workload depends strongly on the underlying diseases of the patient population visiting the outpatient clinic and functional test labs. Table 5 shows the proposal of the Dutch Society of Cardiology concerning the functional tests regarding the different diagnostic groups. Substantial deviations from these guidelines should trigger the medical management of an outpatient clinic to evaluate the clinical practice of the doctors concerned.

3.3. Continuous improvement model

Part of the developed continuous improvement model is shown in this paper. It describes the process steps that together form the patient journey in the outpatient clinic, from referral until the letter to the referring doctor. In each process step, variables influencing the fluency of the process step were determined, as well as the parameters that can be measured to determine the fluency. In Figure 1, this model part is shown, in which the duration of each process step is used as fluency parameter. To optimize each process step, one can tune the process by changing the parameters the process is dependent on.

Dependencies in the process steps in Figure 1 are as follows:

1. Process duration in the planning step is for example dependent on the amount of staff members, the possibility to plan far in the future, and the way referral is done (analogously or by electronic methods)
2. The time duration in the arrival process is dependent on the number of patients seen in a particular time period and the delay that is observed further in the process.
3. The time duration in the process step in which the ECG and blood pressure are measured is dependent on the number of staff available, the amount of equipment available, the amount of training as well as the length of the measurement process.

4. The duration of the visit process step is dependent on the length of the appointments, the number of doctors simultaneously holding practice
5. The length of the letter process step is dependent on the delay between visit and the availability of the voice recording, the length of the letters and the amount of typists available.

Other parts of the continuous improvement model describe patient output at function tests, such as for example echocardiography.

3.4. Computer system for monitoring and enhancing the patient throughput

During the project it became obvious that pro actively monitoring the workflow is the best method to reach optimal results. We developed a prototype of a computer system that is able to present in a "dashboard" like manner the above described indicators and their state. All indicators can be adjusted and are, when relevant, time dependant. Table 6 shows some indicators that are being monitored by this prototype. The first row shows as static indicator the number of reports for the general practitioners waiting to be completed, while the number of the performed functional tests is a time dependant indicator (row 2). The third row again is a static indicator: the agenda planning horizon. The next row is used to detect deviations from the guidelines (table 5) where a "1" corresponds to an "X" in table 5; if more than 100 patients in this group deviate from the standard guideline, an alarm is set. Finally an indicator is constructed representing the ratio between the number of performed functional tests and the number of visits to the outpatient clinic. The indicators are grouped in main categories based on the functionality of the indicator. Depending on the local circumstances information is entered automatically or by hand.

Table 6. See text

Indicator	Threshold	Time dependant	Current threshold	unit
GP report	200	No	200	number
# echos	7000	Yes	4083	number
OPC wait	21	No	21	days
Rhythm	10110	No	100	function
#FT/visit	0.9	No	0.9	ratio

In figure 2 the "dashboard" is shown. It consists of a number of screens, each concerning a different indicator group and a summary screen where the exceeded thresholds are marked. In the example the number of reports for the general practitioners waiting to be processed has exceeded the threshold. In the summary screen the corresponding label has turned red and in the report screen the detailed information on which threshold has been exceeded is also highlighted.

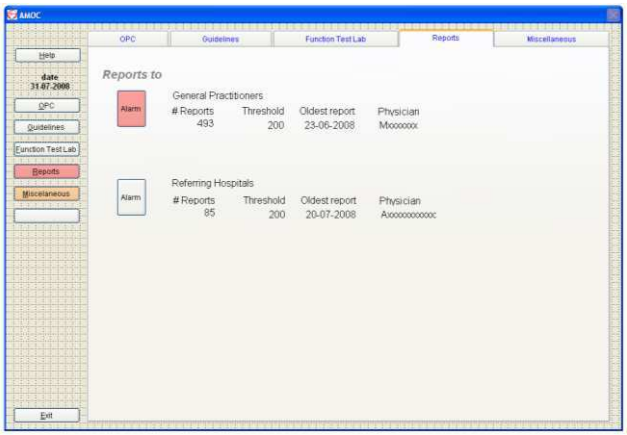

Figure 2. Snapshot of a dashboard screen.

4. Discussion and conclusions

Optimizing the workflow in an outpatient clinic is often based on biased views of the management. Objective indicators can bypass this drawback. In this pilot, the timely presentation of objective indicators proved to be a very supportive tool. Where previously the necessary information was always late, this system facilitates adequate responses to alarms. Because the indicators cover different parts of the process, also the weakest part of the chain is more precisely located. As the local circumstances concerning the ICT-infrastructure were different, the computer system has been differently incorporated in the different clinics. The revealed weaknesses in the different workflows initiated projects varying from the introduction of screening echo's and minimizing the number of follow-up visits to the creation of an electronic network for fast cross enterprise sharing of results of functional tests (IHE XDS).

References

[1] Kritchevsky SB, Simmons BP. Continuous quality improvement. Concepts and applications for physician care. JAMA 1991;266:1817-1823.

[2] Gibbons RJ, Smith SC Jr, Antman E. American College of Cardiology/American Heart Association clinical practice guidelines: Part II: evolutionary changes in a continuous quality improvement project. Circulation 2003;107:3101-3107

Address for correspondence

W.A. Dijk
Thoraxcenter, University Medical Center
Hanzeplein 1, 9713 EZ Groningen, The Netherlands
W.A.Dijk@thorax.umcg.nl