

Application Form Based Optimization of the Echo Lab Workflow

J Ruys, J Koster, WA Dijk, W van der Velde, GAJ Jessurun, DJ van Veldhuisen

University Hospital Groningen, Thoraxcenter, Groningen, The Netherlands

Abstract

In 2001, the number of echocardiograms performed at the University Hospital Groningen has exceeded the 5500. This is an increment of 13.5% compared to two years before. This number is expected to increase further, as improvements in the clinical application and structural changes in the organization progressively evolve. Real time reporting and digital storage of the ultrasound images had a major beneficial impact on the optimization of the total process.

Currently, clinical supervision by experienced operators is possible through the implementation of Apple Macintosh machines, connected to a local network. This connection is subsequently able to provide the entire hospital area network, following the conversion of the Apple platform into Microsoft Windows variants. Albeit, a significant improvement in the efficiency of clinical supervision was achieved, further research is implemented to continue the update process.

1. Introduction

The cardiology department of the University Hospital Groningen is equipped with three examination rooms with GE Vingmed's System Fives for performing echocardiograms. Every examination is scheduled on an appointment basis, where the requesting MD needs to fill out a form, by hand, on beforehand. There are 25 possible types of examinations to request for and a huge number of combinations thereof. Every application request is then supervised for scheduling.

In this study, we investigated the two most popular cases: the request for the Left Ventricular Function (LVF) and the Mitralis Insufficiency (MI) in combination with the LVF. These represent 17% and 4.5% of all requests in the year 2001, in which 5500 echocardiograms were performed in total.

In that year, there was a significant increase in performing echocardiograms compared to earlier years, as the result of a re-organization, including the increase of the use of a third examination room. This resulted in a

growth rate of 13.5% in 2001.

But even with the new higher capacity to perform more echocardiograms, the hospital is urged to have this growth rate increase even more, due to the typical Dutch, infamous waiting lists.

2. Objective

The objective of this project was to have the Echo Lab work more efficiently by predicting the time necessary for an examination, done by computer.

The production has already been increased by the introduction of digital video equipment to replace the good old VHS tape system, now eliminating the time to fetch the one tape and winding it. Having all Systems Five digitally connected in GE Vingmed's Echopac Network, images can be retrieved on the fly, which proves to be an enormous progression in the daily workflow.

Still, there were gaps in this workflow. Echo Lab technicians stated that the flow of patients could use some more efficiency, based on the presentation of the request.

3. Method

The information needed to compute a year's production of echocardiograms was extracted from a database environment called Infocop [1], which is developed and maintained strictly for and by the department of Cardiology. The data we wanted to extract was entered over the year through GRIT, the Graphical Infocop Tool [2], an application that serves as a front-end Graphical User Interface for the Infocop database.

The moment the patient has arrived and is invited in for the examination, a new report is created when entering the patient's ID. Automatically the starting time of the examination is filed.

Once the examination has ended, the technician concludes with entering all the findings. At that time the end time is stored, as where we are able to compute the time that the examination took place.

Because there is time needed to prepare the room for the patient as well, we included an offset for our calculations, in this case 10 minutes.

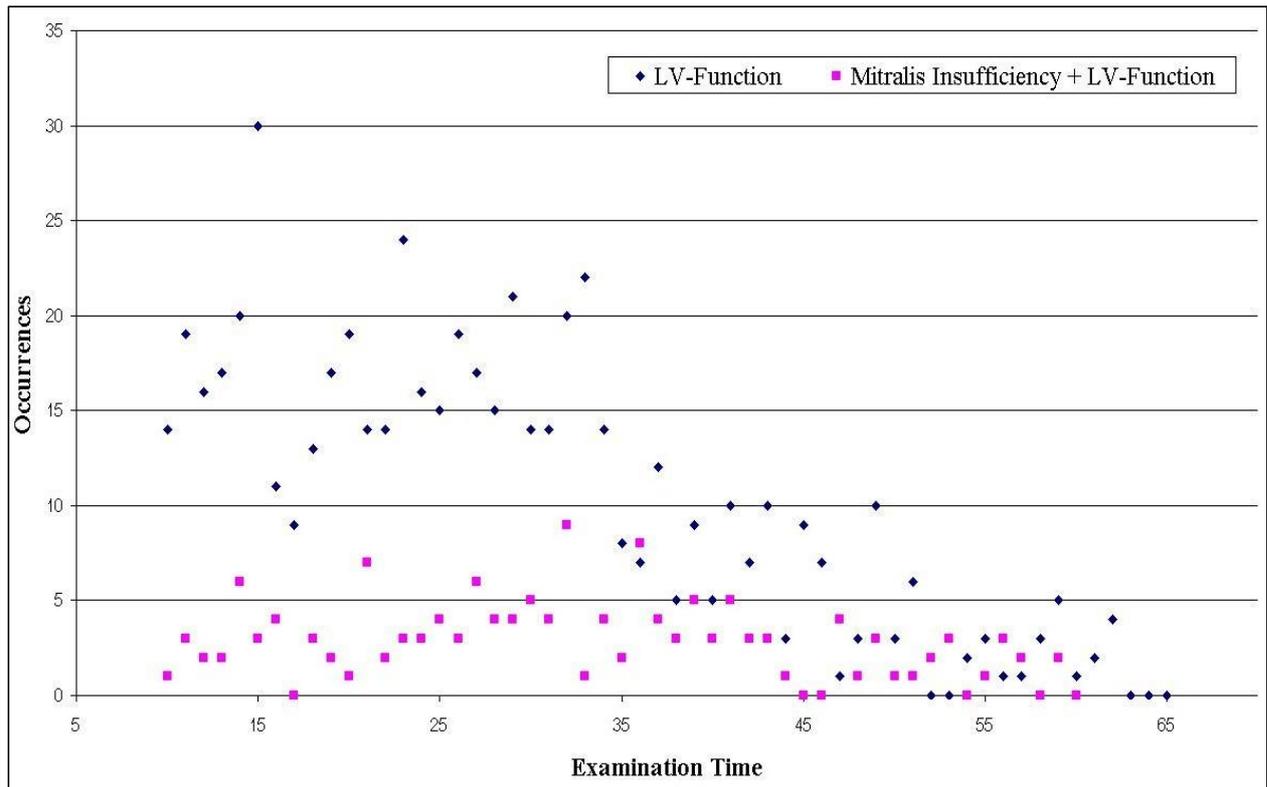


Figure 1. Frequency of different duration's of the examinations where the LV-function or the Mitralis Insufficiency in combination with the LV-Function was requested over the year 2001.

Figure 1 shows the outcome of these calculations where we put the number of occurrences against the time the examination lasted.

From these results, we calculated the medians for the two different types of examinations. Table 1 shows that especially the examination with the application request of the combination of the MI and the LVF can be scheduled for a time slot of at least 10 minutes smaller.

Table 1. Duration statistics on one year's production of echocardiograms with two specific application requests.

	LV-Function	Mitralis Insufficiency + LV-Function
Min	10	10
Max	62	64
Median	26	32
Scheduled	30	45
Difference	-4	-13

4. Implementation

As of January 1st this year, application requests are filled in electronically and likewise processed, as it is sent to the administrative department where all application requests are collected and scheduled in a daily program. In most cases the request has already been given a suggested time slot, which the computer has referenced against a default timetable as a template. We started off with the 15 most popular combinations of application requests and lowered the duration for MI+LVF request from 45 to 35 minutes.

In some cases a suggestion for a time slot can not be given, as we did not specify all possible request combinations. For those cases manual supervision is still required.

5. Results

Using the same algorithm and procedures, again we calculated the medians of the same types of requests for the echocardiograms. With this new template in use the first half of 2002, we noticed a slight increase in workflow.

Figure 2. Example of the electronic application request form.

Table 2 contains the results over this year's first six months, with the computer-aided scheduler installed.

Now, would we like to determine the average number of performed echocardiograms a day, the magic number for 2001 would be 22. But with the new procedure and templates we reached 23.2 examinations per day as an average for the first half of 2002. See Table 3.

Table 2. New LVF and MI+LVF results.

	LV-Function	Mitralis Insufficiency + LV-Function
Min	10	10
Max	57	58
Median	27	31
Scheduled	30	35
Difference	-4	-4

Table 3. Average numbers of examinations in the Echo Lab using the paper application forms in 2001 and the electronic versions in 2002.

	2001	2002, 1 st six months
Average number of echocardiograms per day	22	23,2

6. Discussion

It seems obvious that the echocardiogram's management comes with the quality of the physical examinations and the accuracy of the patient's medical history administration. Listening carefully to the patient during the anamnesis consult is also of great importance for the quality of an echocardiogram as the MD will request for the right functions to be examined. Although we have eliminated one link in the chain of the request procedure, namely the employee that would type over the request from a written form into the computer, it is important to prepare the technician for what to look for.

Other aspects of influence on the duration of the

examination without losing any quality are the technician's skills and experiences. Being an academic hospital, the arsenal of technicians with skills ranging from a first year student to the experienced cardiologist varies. During our study though, the manpower was quite constant.

Also, predicting the duration of an echocardiogram becomes more inaccurate when there are more complications. For example, an echocardiogram of a normal Left Ventricular Function will take less time to complete than one with a bad LVF. This cannot be foreseen at time of filing the request.

Along with these recurring situations, there are a lot of variables left that might have a significant influence on the Echo Lab's daily workflow. Evaluation on a regular basis to tweak this flow is advised, keeping in mind that a patient's short waiting time is paramount.

Acknowledgements

We wish to thank GE Vingmed and GE Marquette for their financial support.

References

- [1] Dijk W A, Haagen F D M, Infocop, Information System for Catheterized and Operated Patients, In: Computers in Cardiology 1984. Salt Lake City: IEEE Computer Society Press; 1984: 241.
- [2] Ruys J, GRIT: Graphic Infocop Tool for the Catheterization Lab, 1996
- [3] Segar S, The Digital Echocardiography Laboratory, The practice of Clinical Echocardiography, Second Edition; 2002: pp. 947-958.

Address for correspondence.

J. Ruys
Thoraxcenter (Cardiology)
Groningen University Hospital
P.O. Box 30 001
9700 RB Groningen
The Netherlands
J.Ruys@thorax.azg.nl