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How to Optimise Your Lab And Face The Crisis

Author

Mads Nybo, *MD, PhD*

Dept. of Clinical Biochemistry and Pharmacology

Odense University Hospital

Denmark

mads.nybo@rsyd.dk

Key Points

• Despite steadily increasing costs hospital laboratories are under pressure to improve their services to the hospital.

• A lab automation process provides opportunities to improve workflow and productivity

• This article describes the outcome of such a process as conducted at Odense University Hospital, Denmark.

• Through consolidation of blood samples (reduced 20%) and analyses instruments (reduced 25%), an overall economic saving of 37% was achieved.

• Turnaround times (time from sampling to answer) were reduced by 55% (median 14.1 hours (IQR 1.9-30.2)

in 2007 to 2.0 hours (IQR 1.7-2.6) in 2011).

One of the many challenges modern hospital management faces is the economic issue with steadily increasing costs in every corner of the hospital. Seen from a laboratory point-of-view, the laboratory seems to reflect the hospital in terms of increased workload, increased test demands and increased economic demands. In general, the demands for a modern hospital laboratory can be summed up as follows:

• Increasing amount of blood samples;

• Increasing demands for analyses available on the test menu;

• Increasing demands to improve turnaround- time (i.e. the faster the better);

• Increasing quality demands;

• And at a low or no increased cost. This seems impossible to overcome.

However, there are some opportunities to be grasped. There is growing focus on the area from both the hospital administration as well as from the international companies producing analysis equipment. Attention from the local administration makes it feasible to define demands within the hospital and get specified requirements from the departments using the laboratory. Focus from the companies has led to a dramatic increase in new technologies supporting faster turnaround- times (TATs), which is the time measured from when the blood sample is taken until the analysis result is presented in the lab information system. These technologies include transportation of the blood samples, automated receipt of the samples at the lab, and a track combining different types of analysis instruments in order to decrease manual sample handling. IT solutions have

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improved considerably, enabling the laboratory to handle requests more rapidly and also to transmit the results as fast as possible.

Finally, the possibility of using pointof- care equipment, i.e. small analysis units placed on the wards and operated by local staff, makes it possible to tailor the laboratory service to the needs of the individual departments in terms of analysis availability, TATs etc. With all these new opportunities it therefore suddenly seems possible to reach the goals set in a modern hospital.

We will briefly describe our experiences with a lab automation process and the outcome in terms of TATs, analyses produced and fiscal issues. Our goal was to quantify the monetary value of process improvements due to implementing automated instrumentation and process optimisation. For this, production numbers from 2007 and 2011 (before and after the automation process) were used.

Local Experience

Odense University Hospital has 1,115 beds, 1,025,000 ambulatory treatments (2011 numbers), while the laboratory has 260 employees with an academic staff of ten involved in routine analyses. The Lab has a 24/7 service, incl. phlebotomy, which means that routine production continues 24 hours every day, and lab technicians are responsible for the main part of the blood sampling over the entire period. The Lab receives samples from in- and outpatients, including from general practitioners, which gives a total of approximately 6,000 tubes per day. As shown in Figure 1, the number of tests performed has increased steadily during the last six years. To meet these increasing demands possible process optimisations at the Lab were investigated:

Very simplified, the logistic flow can be divided into the following processes:

• Test requisition;

• Blood sampling;

• Blood sample transportation;

• Blood sample handling at the Lab;

• Analysis;

• Storage.

Here, we address the issues of sample transportation, sample handling and analysis.

Sample Transportation

If sample transportation is automated several things are achieved. Overall, the key issue is of course faster TATs, but also, more uniform, simplified sample handling facilitates optimisation of the sample flow at the Lab. Most new equipment is capable of receiving samples from transportation systems, which enables faster, automated handling and reduces manual handling. Finally, the risk for samples getting lost or too old for analysis (due to stability issues) is minimised. To achieve this, we introduced a sample transportation system capable of sending samples from phlebotomy wards and hospital wards continuously, which can reach the Lab within 40 seconds. Also, a bulk receiver was installed, where samples automatically are registered as arrived at the Lab and then sorted for different analysis instruments(see Figure 2). The samples do not yet arrive at the analysis track, but this will be the next automation step.

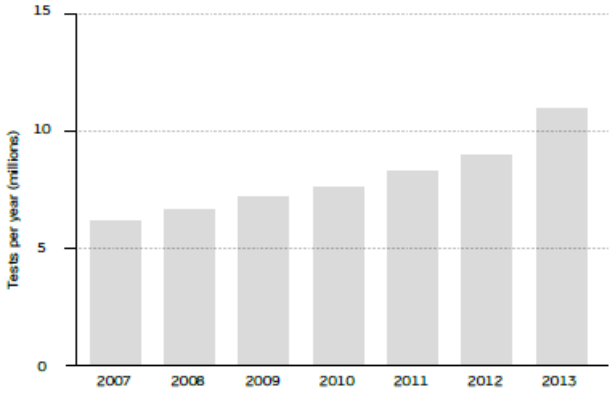

Figure 1.
Number of tests performed at the Lab in the years 2007-2013.

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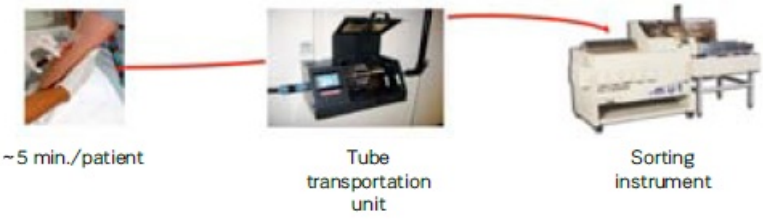

Figure 2.
Instead of transporting samples from ward to ward on trolleys, an automated pneumatic transportation system, capable of sending every tube one by one (no packing needed), was introduced along with a sample bulk sorter to receive the samples.

Consolidation

As shown in Figure 3, an important key to optimisation was consolidation of tubes and equipments, respectively:

• Consolidation of the sampling tubes minimises the number of phlebotomies, the number of samples to be transported and thereby the number of manual sample handlings. Also, fewer tubes will make alternative transportation strategies more feasible. Finally, each tube generates additional work and cost in terms of production and disposal after use.

• If more analyses can be performed on the same equipment, this will give many benefits. It will require fewer tubes, and, due to fewer instruments, it will require less preventive maintenance (which is costly), improve laboratory environment due to fewer instruments making noise and heat, and in the end improved workflow due to the fewer tubes and instruments required (Figure 4). This will in the end improve TATs, which was also one of our key parameters.

Serum analyses were converted to plasma analyses where possible, in order to perform more tests in the same tube. Also, tests were moved from other equipment to the same analysis platform. Worth mentioning is that the track arrangement connecting these instruments enabled automated storage, so again manual sample handling was minimised. This arrangement makes it possible to easily retrieve samples for additional analyses, if the clinicians wish to add a requisition to an already obtained sample.

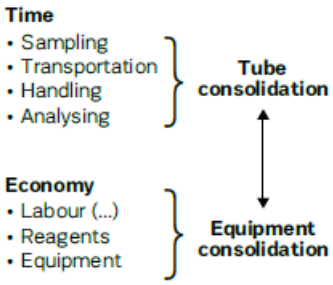

Figure 3.
The two main drivers, time and economy, are both vastly affected by consolidation processes due to the effect on the different sub-processes mentioned. As indicated, consolidation of tubes gives a synergistic effect with equipment consolidation.

Outcome

As shown in Figure 5, the number of instruments was reduced by 25%, which gives an economic advantage in terms of lower service costs, less electricity and less space needed. The number of tubes was reduced by 20% (from 6.6 tests per tube to 7.9 tests per tube), which enabled the Lab to perform an increasing number of tests in the same number of tubes. Just as important, TATs were reduced by 55%: from median TAT/test 14.1 hours (IQR 1.9-30.2) in 2007 to 2.0 hours (IQR 1.7-2.6) in 2011.

And finally, the reduction in instruments, employees etc. gave an overall saving of approximately 37% as shown in Figure 5.

Conclusions

Despite continuous economical challenges it is possible to not only improve the laboratory service, but also to achieve savings through this process. One key word is automation, and as shown above it has resulted in a number of solid improvements at our University Lab. The savings mentioned should of course be interpreted cautiously, as some of the employee savings were used to transfer personnel to other tasks, and the savings made it possible to invest in a continuous automation process: As depicted above, such a process needs investments to get started, here by introducing new transportation solutions, automated sample reception and a consolidated track solution for the analyses.

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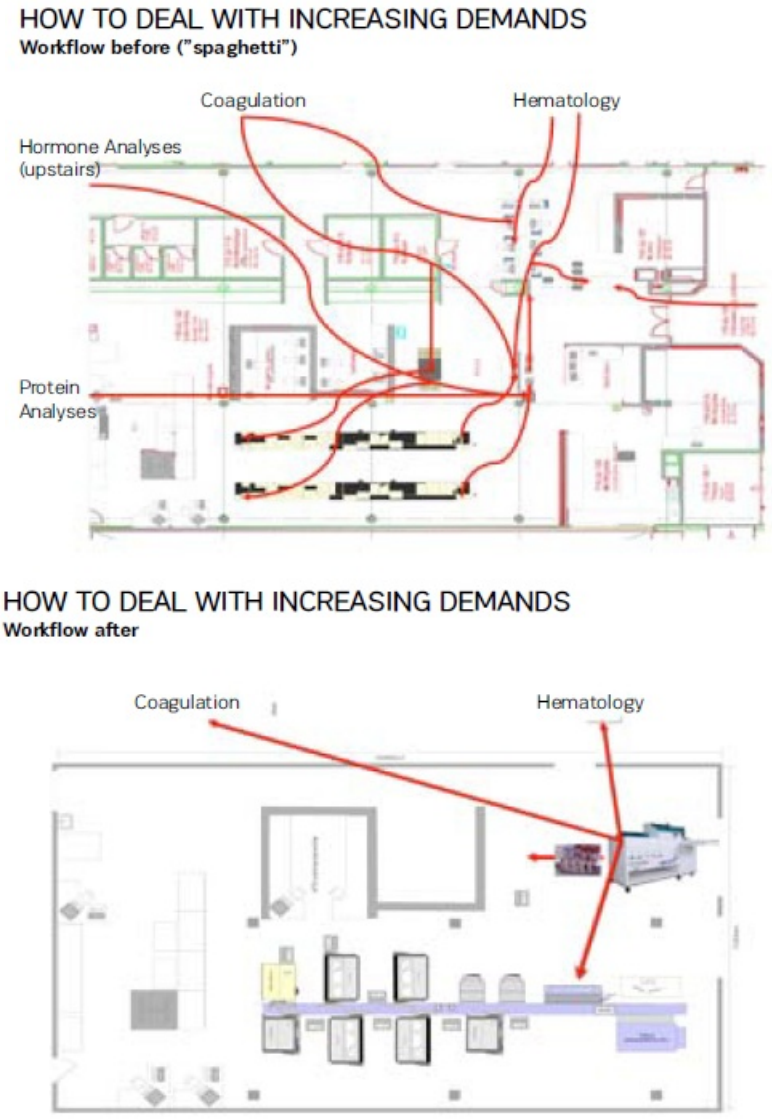

Figure 4.
Workflow before and after consolidation. As described in the text this was obtained by consolidating tubes and consolidating instruments whenever possible.

Another key word is continuous, as this is merely the beginning of a process, where a number of further improvements still lie ahead. A number of areas can be addressed, and here some of the forthcoming issues should be mentioned. On the request area, so-called "diagnosisoriented analyses panels" (anaemia, fatigue, cancer suspicion) need to be optimised, and also, unnecessary and/or repeated requests must be eliminated. For blood sampling, there is an ongoing debate concerning the possibility of robot sampling – this does, however, seem to lie some time ahead. Other possibilities are increased local sampling (which will require training of nurses etc.) and the use of capillary samples, e.g. for point-of-care analysis as mentioned. For sample transportation, pneumatic tube transportation of all samples, sorted directly onto the instrument track, is more or less available for all instruments on the market today and must be acquired. And as for analyses, continuous consolidation of additional analytical platforms is of course mandatory.

Altogether, automation is indeed an opportunity for every laboratory to trim their processes and improve their service, but it is also a process that will continue as long as laboratory services are needed. As emphasised, other parts of the process also need scrutiny in order to refine the laboratory service. Again, remember that such processes needs investments to get started, but the payback indeed seems to be worth the investment.

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Cost reduction per test	÷ 37%
Reduction in TAT	÷ 55%
Reduction in blood drawings	÷ 20%
Less instruments	÷ 25%
Less maintenance	-
Less space, noise and working places	-
Less inventory and consumables	-
Less cost for consumables	-
Less waste - better for the environment	÷ 70.000 €/year savings
Less manual work - saves > 3 hours/day	750 h/year reallocated
Minimising hands-on	
Fewer persons overall	4 FTE re-deployed

Figure 5.
Outcome of the automation process. Please see text for specific details.

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