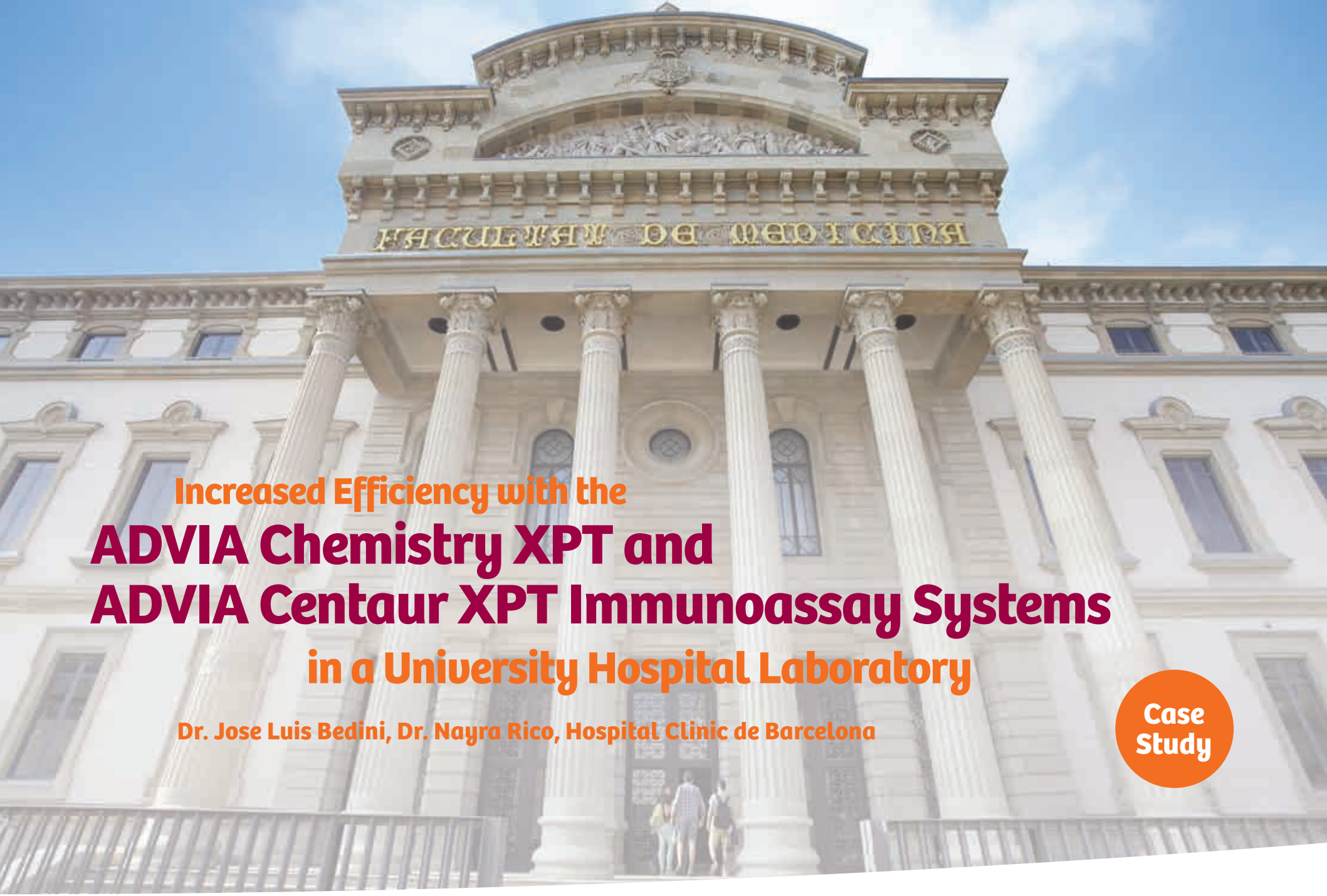

Increased Efficiency with the

ADVIA Chemistry XPT and ADVIA Centaur XPT Immunoassay Systems

in a University Hospital Laboratory

Dr. Jose Luis Bedini, Dr. Nayra Rico, Hospital Clinic de Barcelona

Case Study

SIEMENS Healthineers

Increased Efficiency with the

ADVIA Chemistry XPT and ADVIA Centaur XPT Immunoassay Systems

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The ADVIA Chemistry XPT System processed 2856 more samples than the ADVIA 2400 system, despite having worked for 60 hours less. This is a 5.22% higher throughput in 6 months.

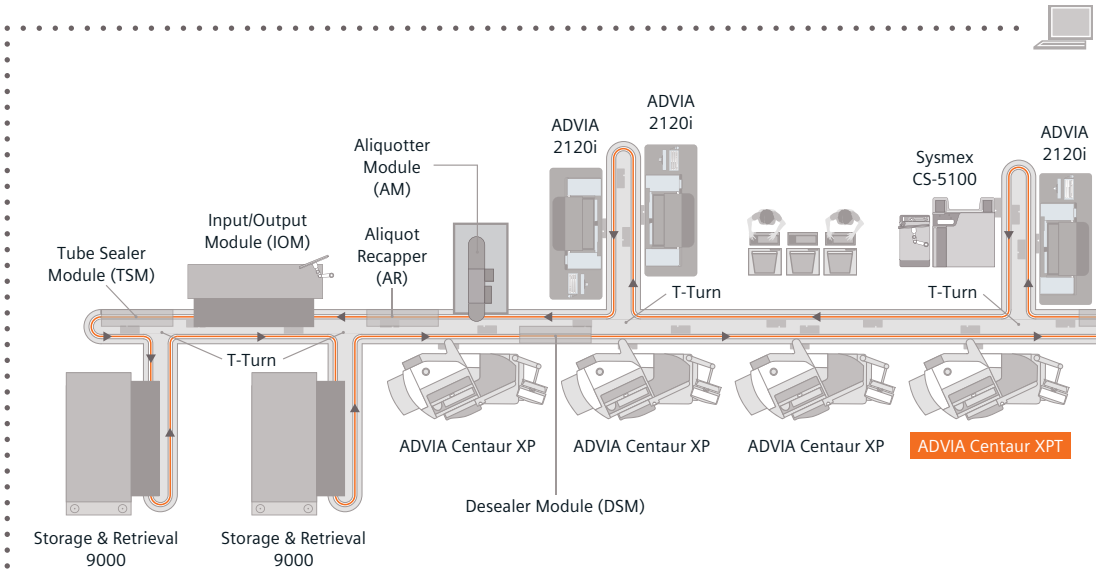


Figure 1. Layout of the Aptio Automation solution, including pre- and post-analytical modules and connected analyzers for

Introduction

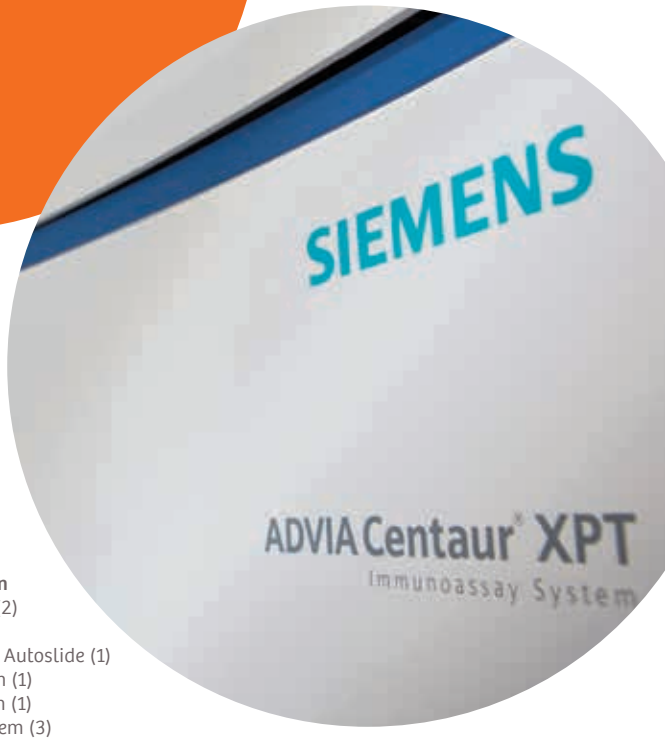
Hospital Clinic de Barcelona is a public university hospital with a total of 850 beds. Within the hospital, the Biomedical Diagnostics Center (BDC) provides integrated, high-quality services in all areas of laboratory medicine and excels in related specializations. The BDC uses a client-oriented model to optimize the use of resources, while considering new developments in advanced research and health technologies.

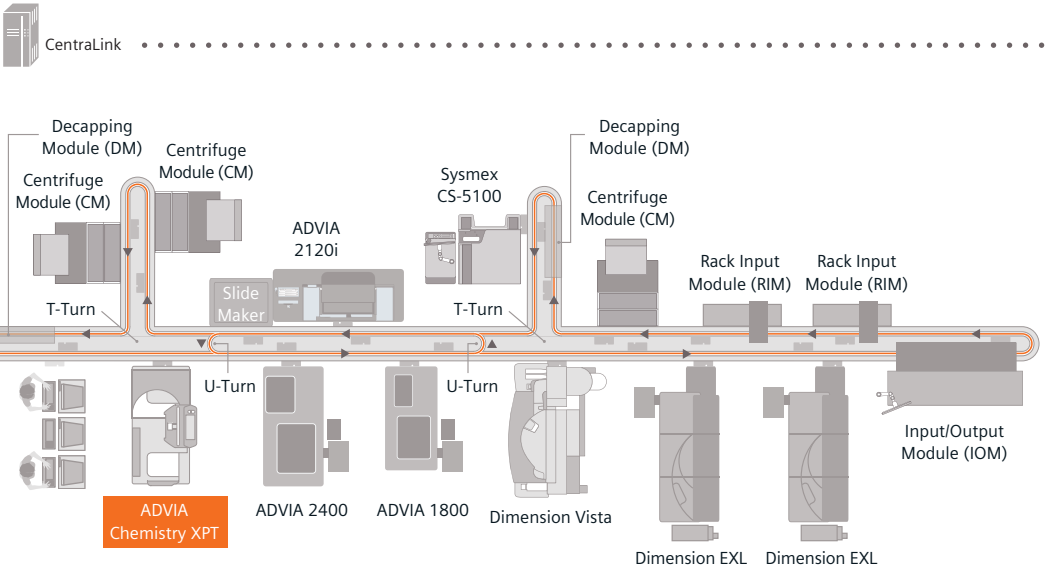
The BDC, which comprises a core laboratory and a molecular biology operating area, services four departments: pathological anatomy, biochemistry and molecular genetics, immunology, and microbiology. The core laboratory is a highly automated 24/7 facility that combines routine activities and emergency requests using Aptio® Automation. The multidisciplinary laboratory offers testing for general biochemistry, immunochemistry, hematology, and coagulation. In 2015, our annual throughput was 433,682 hematology tests, 367,579 hemostasis tests, 3,414,007 clinical chemistry tests, and 347,070 immunochemistry tests.

Aptio Automation was installed in 2013 and consists of a central track with connected systems. This solution performs preanalytical centrifugation and decapping and postanalytical processes such as sealing and archiving of tubes in the refrigeration modules. Figure 1 shows the core laboratory layout in 2016.

In September 2014, a new Siemens ADVIA® Chemistry XPT System was incorporated into the core laboratory. The ADVIA Chemistry XPT System replaced one of our ADVIA 2400 Clinical Chemistry Systems. Also, an ADVIA Centaur® XPT Immunoassay System was incorporated into our laboratory's immunochemistry area, replacing one ADVIA Centaur XP Immunoassay System.

With the ADVIA Centaur XPT system, we realized an annual savings in operator time of 60 hours and an average reduction in turnaround time of 6%.





Systems connected to Aptio Automation

- Sysmex® CS-5100 Hemostasis System (2)
- ADVIA 2120i Hematology System (3)
- ADVIA 2120i Hematology System with Autoslide (1)
- ADVIA 2400 Clinical Chemistry System (1)
- ADVIA 1800 Clinical Chemistry System (1)
- ADVIA Centaur XP Immunoassay System (3)
- ADVIA Centaur XPT Immunoassay System (1)
- ADVIA Chemistry XPT System (1)
- Dimension Vista® 500 Intelligent Lab System (1)
- Dimension® EXL™ with LM Integrated Chemistry System (2)
- CentraLink® Data Management System (1)

Pre- and postanalytical modules connected to Aptio Automation

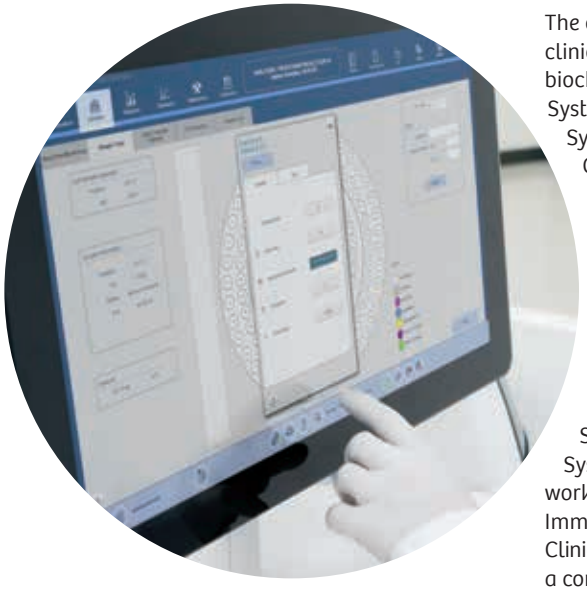
- Rack Input Module designated for loading (2)
- Input/Output Module designated for loading, unloading, sorting (2)
- Centrifuge Module (3)
- Decapper Module (2)
- Tube Sealer Module (1)
- Tube Desealer Module (1)
- Refrigerated Storage and Retrieval Module: 9000 tubes (2)
- Aliquotter (1)
- Aliquot Recapper (1)
- Track U-Turn (2)
- Track T-Turn (6)

hematology, hemostasis, clinical chemistry, and immunochemistry.

The Biomedical Diagnostic Center* (BDC) at a glance:

- Serves a local population of **550,000** people.
- Processes **550,000** orders from hospital and ambulatory patients annually.
- 3,414,000 clinical chemistry tests annually.
- 347,000 immunochemistry tests annually.

*The BDC comprises all laboratories of the Hospital Clinic de Barcelona.



Objectives

We designed an evaluation to assess:

- The impact of the throughput advantages offered by the ADVIA Chemistry XPT System and ADVIA Centaur XPT Immunoassay System compared to those of the legacy instruments in our laboratory
- Result response times (turnaround time) observed with the ADVIA Chemistry XPT System and ADVIA Centaur XPT Immunoassay System versus those of the legacy systems
- Improvements in analytical precision performance for ISE results with the ADVIA Chemistry XPT System compared to those with the ADVIA 2400 chemistry system
- Usability, determined through improved operating time and fewer user interventions, with less manual hands-on time

Materials and Methods

The core laboratory uses three ADVIA clinical chemistry analyzers in the general biochemistry area: an ADVIA Chemistry XPT System, an ADVIA 2400 Clinical Chemistry System, and an ADVIA 1800 Clinical Chemistry System. The three analyzers start running at 7.30 a.m. and are switched off sequentially. For the study, the ADVIA Chemistry XPT System was switched off 30 minutes before the ADVIA 2400 Clinical Chemistry System.

Assay performance was observed on routine samples over a 6-month period for the ADVIA Centaur XPT Immunoassay System and the ADVIA Chemistry XPT System. To meet the study objectives, we worked in parallel with one ADVIA Centaur XP Immunoassay System and one ADVIA 2400 Clinical Chemistry System, allowing us to perform a comparative study. ISE module stability was determined using BIO-RAD controls and BIO-RAD Unity Real Time software.

Significant improvements in processing times have been achieved with the combination of the Aptio Automation solution and connected ADVIA Chemistry XPT and ADVIA Centaur XPT Immunoassay Systems.

	ADVIA 2400 Chemistry System	ADVIA Chemistry XPT System (running 60 hrs. less)	Percentage Change
Tube throughput in 6 months	54,696	57,552	+5.22
% requiring ISE tests	82%	83%	–

Table 1. Throughput on ADVIA Chemistry XPT System and ADVIA 2400 Clinical Chemistry System.

Analyzer	Test	Average mmol/L	SD	%CV	N	SDI	RCV	Calibrations
ADVIA XPT	Sodium	142.92	0.98	0.68	186	0.62	0.65	16
ADVIA 2400	Sodium	142.62	0.74	0.52	200	0.41	0.49	38
ADVIA XPT	Potassium	4.16	0.05	1.18	188	0.31	0.79	16
ADVIA 2400	Potassium	4.18	0.09	2.07	271	0.02	1.39	38
ADVIA XPT	Chloride	97.10	0.71	0.73	178	0.43	0.45	16
ADVIA 2400	Chloride	97.76	1.26	1.29	231	0.01	0.78	38

SDI: standard deviation index; RCV: relative coefficient of variation; Calibrations: number of calibrations during the study; N: includes repeat testing of quality controls.

Table 2. Analysis of internal control results on the ISE module (Na^+, K^+, Cl^-): BIO-RAD Liquid Assayed Multiqual 2 control.

Dr. Jose Luis Bedini, Head of Biomedical Diagnostic Center Core Laboratory, Hospital Clinic de Barcelona.

On the basis of improvements incorporated into the ADVIA Chemistry XPT System and ADVIA Centaur XPT Immunoassay System, we assessed possible time savings for instrument maintenance, calibration, and reagent-loading processes.

To assess the impact on turnaround times (TAT) by incorporating both ADVIA XPT systems into the daily routine, we calculated the average turnaround (TAT_{av}) for determination of the glucose oxidase assay on the ADVIA Chemistry XPT System and the eHIV assay on the ADVIA Centaur XPT system. Glucose oxidase and eHIV were chosen because they are the tests most frequently performed on their respective instruments.

Results and Discussion

ADVIA Chemistry XPT System: throughput comparison

The most significant manufacturer's improvement on the ADVIA Chemistry XPT System is the newly designed ISE module, which reduces maintenance and requires fewer manual interventions. Other improvements include intuitive, user-friendly software with customizable screens; easier access to samples requiring immediate operator attention; and fast "on-the-fly" replacement of reagents and system fluids.

During the 6 months of the study, the ADVIA Chemistry XPT System analyzed a total of 57,552 serum, urine, and other biological-fluid sample tubes. Sodium, potassium, and chloride electrolytes were measured in 83% of the samples. In the same time period, the ADVIA 2400 Clinical Chemistry System analyzed a total of 54,696 tubes, with analysis of the same electrolytes in 82% of the samples.

The ADVIA Chemistry XPT System processed a higher number of tubes while working for less time than the ADVIA 2400 chemistry system. In fact, the ADVIA Chemistry XPT System processed 2856 more samples than the ADVIA 2400 chemistry system, despite having worked for 60 hours less. This is a 5.22% higher throughput over 6 months. These results led us to the conclusion that either the ADVIA Chemistry XPT System was faster in processing samples, or less time was lost in manual interventions, such as replacement of reagents, resolving technical issues, maintenance activities, calibration, and reviews. Although most of the tubes underwent ISE testing on the ADVIA Chemistry XPT System, the reduced maintenance of the ISE module and a lower number of calibrations may have contributed to its better performance in comparison to the ADVIA 2400 Clinical Chemistry System (Table 1).

ISE module: analytical precision performance

BIO-RAD's Unity Real Time software was used to determine precision and accuracy of internal control recovery. We calculated the coefficient of variation (%CV) and assessed the degree of imprecision by comparing our results with those obtained with BIO-RAD Liquid Assayed Multiqual 2 (Table 2).

As shown in Table 2, both the ADVIA Chemistry XPT System and ADVIA 2400 Clinical Chemistry System showed excellent analytical precision, with a CV of <2.5% for all analytes. The CVs for potassium and chloride on the ADVIA Chemistry XPT System were significantly lower than those on the ADVIA 2400 Clinical Chemistry System. For sodium, the CV was minimally higher on the ADVIA Chemistry XPT System than on the ADVIA 2400 Chemistry system, but CVs obtained on both systems were in the range expected for excellent analytical precision. We want to stress that only the results falling within the range were used for the CV calculation. The ADVIA Chemistry XPT System needed 58% fewer calibrations and 7% fewer quality control (QC) results than the ADVIA 2400 chemistry system in the same period of time. Overall, we noted a greater number of measurements of the internal control material on the ADVIA 2400 Clinical Chemistry System versus the ADVIA Chemistry XPT System. This is due to verification of the frequent calibrations needed to maintain the stability of the ISE measurements. We would highlight the product and process improvements of the ADVIA Chemistry XPT System and the cost reduction achieved by use of less QC material, calibration material, reagents, and consumables.

Key Outcomes and Benefits:

ADVIA Centaur XPT Immunoassay System

- Longer system uptime and faster availability of results reduced the average turnaround time for immunochemistry results by 6%
- Automated daily controls and automated water reservoir cleaning with UV light saved 42 hours of labor per year
- Reduced monthly maintenance requirements saved 18 hours of labor per year

ADVIA Chemistry XPT System

- Average turnaround time for chemistry results improved by 15% while increasing throughput by more than 5%
- Improved ISE module eliminated operational and maintenance activities, allowing for 70 more hours of run time annually
- Streamlined reagent-loading on the system saved about 42 hours annually

"The ADVIA Chemistry XPT System's new ISE module offers enhanced stability and performance. This allows us to reduce the number of calibrations and eliminates ISE module maintenance. The new reagent loading process makes it possible to replenish reagent containers faster."

Dr. Nayra Rico
Biomedical Diagnostic Center—Core Laboratory,
Hospital Clinic de Barcelona

System uptime increased 70 hours per year with the ADVIA Chemistry XPT System, improving productivity.

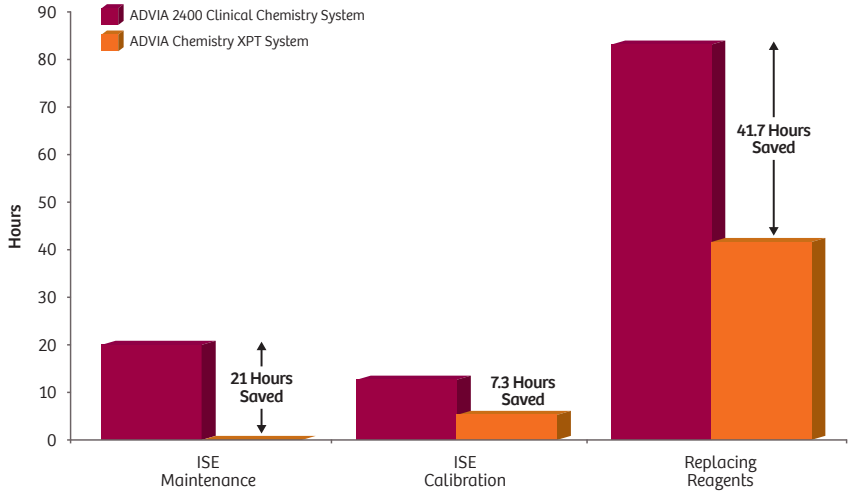


Figure 2. Maintenance time comparison.

Usability and operator intervention

On the ADVIA 2400 chemistry system, the time devoted to daily maintenance of the ISE module is estimated at 5 minutes. The ADVIA Chemistry XPT System does not require these maintenance activities, so the annual savings in operator time is estimated to be 1250 minutes (21 hours).

The improved stability of the ISE module was reflected in fewer calibrations. During the study, the ADVIA Chemistry XPT System's ISE module was calibrated 16 times, whereas in the same period, the ADVIA 2400 Clinical Chemistry System's ISE was calibrated 38 times, or 2.4 times more. The time spent by laboratory personnel on ISE module calibration is estimated at 320 minutes (5.3 hours) on the ADVIA Chemistry XPT System and 760 minutes (12.7 hours) on the ADVIA 2400 chemistry system per year. This means a time savings of 440 minutes (7.3 hours) per year with the ADVIA Chemistry XPT System.

With the ADVIA 2400 chemistry system, the replacement of reagents requires pausing operation of the analyzer to allow level-sensing of all reagent containers on the reagent tray. An advantage of the ADVIA Chemistry XPT System is that only replaced reagent containers are level-sensed. Overall, replacement of reagents and system fluids (detergents, water, and system fluids) has incurred a time savings of 10 minutes compared with the time required for the ADVIA 2400 chemistry system. Assuming that it is necessary to change at least one reagent daily, we calculated a total savings of 2500 minutes per year (41.7 hours) using the ADVIA Chemistry XPT System. Figure 2 shows the time operators need for ISE module maintenance, calibration of the ISE electrodes, and reagent replacement on each of the ADVIA chemistry systems; in total, the time savings for manual intervention is 70.0 hours per year.

Dr. Nayra Rico, Biomedical Diagnostic Center Core Laboratory, Hospital Clinic de Barcelona.

ADVIA Centaur XPT Immunoassay System

The most significant improvement made on the ADVIA Centaur XPT system is the addition of a UV light that prevents microbial growth in the water reservoir, thereby eliminating the monthly cleaning procedure and automatic scheduling of daily quality control result reviews. In the case of the ADVIA Centaur XP system, monthly maintenance to clean the water container requires 90 minutes, giving an annual total of 1080 minutes (18 hours), during which the analyzer cannot be used for sample analysis. With the ADVIA Centaur XPT Immunoassay System, which eliminates this monthly maintenance protocol, the analyzer's productivity improved. On the ADVIA Centaur XP system, internal controls must be performed manually each day, and users must check expiration dates and control lot numbers before operating the analyzer, which takes an average of 10 minutes. On the ADVIA Centaur XPT system, daily controls are performed automatically, saving approximately 42 hours annually. We can now utilize operator time for more important tasks, such as technical validation, allowing earlier release of patient results. Figure 3 shows the time spent by operators on monthly maintenance and performance of controls for each of the analyzers.

	ADVIA Centaur XPT System	ADVIA Chemistry XPT System
Manual time savings per year	Approximately 60 hours	Approximately 70 hours
TAT vs. legacy system	6% shorter	15% shorter

Table 3. Efficiency benefits of ADVIA Centaur XPT and ADVIA Chemistry XPT systems versus legacy systems.

ADVIA Chemistry XPT and ADVIA Centaur XPT systems: turnaround time (TAT)

The TAT_{av} was calculated from the time when the sample tube was introduced to the automation system until the result was obtained. The TAT_{av} for determining glucose oxidase was 60 minutes on the ADVIA 2400 chemistry system and 50 minutes on the ADVIA Chemistry XPT System. The TAT_{av} for determining eHIV was reduced by 5 minutes, from 90 minutes with the ADVIA Centaur XP system to 85 minutes on the ADVIA Centaur XPT system. For core assays, the ADVIA Chemistry XPT System demonstrated a 15% shorter TAT and the ADVIA Centaur XPT Immunoassay System a 6% shorter TAT.

We identified efficiency benefits of the ADVIA Centaur XPT and ADVIA Chemistry XPT systems versus those of legacy systems as shown in Table 3.

Conclusions

The development of the ADVIA Chemistry XPT System's new ISE module offers enhanced system stability and performance. We determined that we could reduce the number of calibrations, and the ADVIA Chemistry XPT System eliminates ISE module maintenance. In addition, the system offers a new reagent-loading process that makes it possible to replenish reagent containers faster than was possible with the ADVIA 2400 chemistry system. Through these improvements, we can save approximately 70 hours of operator intervention annually. Finally, the ADVIA Chemistry XPT System has reduced the average turnaround time by 15%.

The ADVIA Centaur XPT Immunoassay System also demonstrated time savings realized through the elimination of the monthly cleaning procedure and reduced monthly maintenance protocol. The use of UV light automatically cleans the water reservoir container and prevents microbiological growth. In addition, the system saves operator time through automatic daily quality control management. With the ADVIA Centaur XPT system, we realized an annual savings in operator time of 60 hours and an average reduction in turnaround time of 6%.

During the study, we have observed measurable time savings that translate into longer system uptime and cost savings and faster result availability, all of which directly support better patient satisfaction.

ADVIA Centaur and ADVIA Chemistry XPT systems have almost identical user-interface software that is very intuitive and easy to use. This software offers various advantages, such as customizable screens, alphabetical sorting, and additional management functions, all of which contribute to easy training and time savings. The study has confirmed that we can expect measurable cost savings.

The outcomes obtained by the Siemens customer described here were realized in the customer's unique setting. Since there is no typical laboratory, and many variables exist, there can be no guarantee that others will achieve the same results.

"We can now utilize operator time for more important tasks, such as technical validation, allowing earlier release of patient results. In addition, the system saves operator time through automatic daily quality control management."

Dr. Jose Luis Bedini
Head of Biomedical Diagnostic Center—
Core Laboratory,
Hospital Clinic de Barcelona

The improved efficiency and automation of the new ADVIA Centaur XPT system resulted in 60 additional hours of availability for immunoassay testing each year.

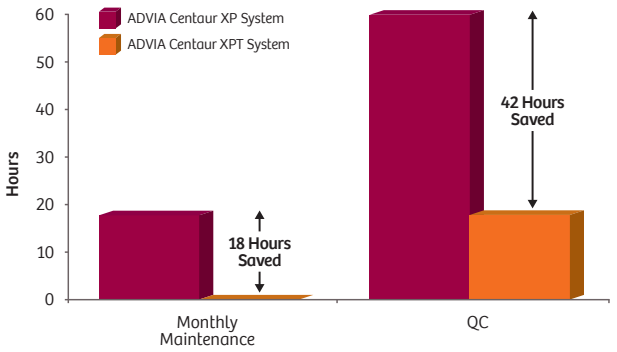


Figure 3. Time savings comparison.

Product availability may vary from country to country and is subject to varying regulatory requirements. Please contact your local representative for availability.

Note: Siemens recommends utilizing proper protective equipment when running samples.

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