

Clinical and Research Laboratories Adopt New Technologies to Navigate Change

Laboratory leaders are using automation, robotics, and artificial intelligence to chart a course for the future

Modern clinical, pharma, agriculture, and research laboratories continue to adapt to changing business environments by adopting new technologies. The emerging solutions are being used to achieve a common set of laboratory business objectives: highest possible accuracy, fastest turnaround time, and lowest cost in a way that meets security and compliance requirements.

Automation, robotics, and artificial intelligence (AI) are enabling new, scalable platforms to help deliver clinical results by using data in new ways and increasing the use of more sophisticated analytics. For example, pathologists are using AI systems in combination with their expertise to expand access to care. Pharma research scientists are employing AI to suggest new drug targets and candidates from complex computer simulations.¹

Intel plays a key role in enabling the new technologies that labs are using today while setting a foundation for the game-changing technologies of the future. With Intel® technology, organizations are better able to:

- Improve workflow and efficiency with automation, robotics, and analytics
- Connect globally distributed labs for improved collaboration and accelerated results
- Support cutting-edge science with high performance computing (HPC) and AI

Let's examine current and emerging technology trends in clinical and research laboratories to see the important role played by advanced computing technologies.

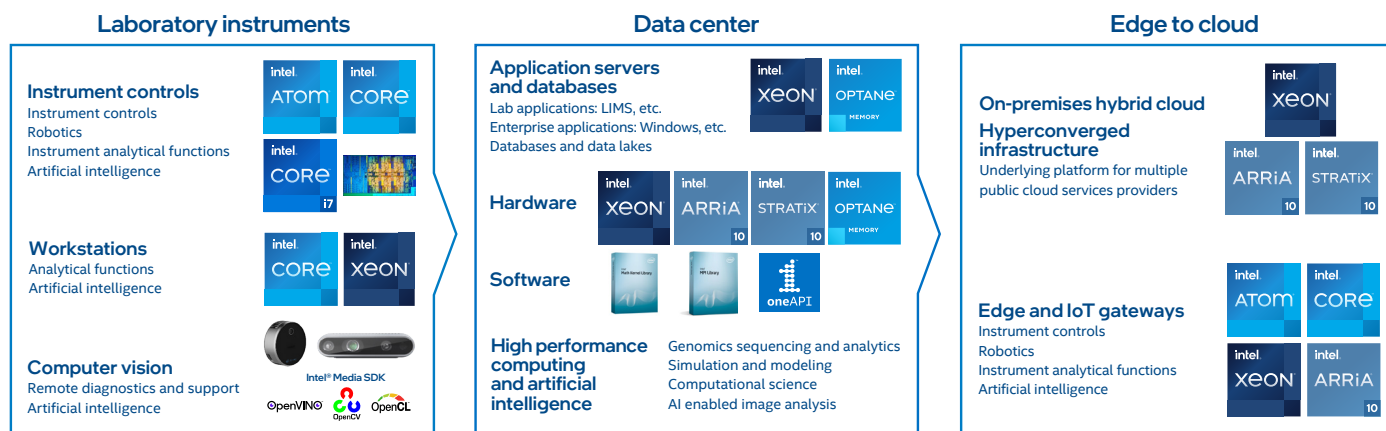


FIGURE 1: Intel® technologies in the laboratory

The clinical lab of the future will be increasingly autonomous and decentralized

The last several years have seen an increased use of automation to support escalating testing volumes and efficiency goals against a backdrop of decreasing reimbursement.^{2,3} Laboratories are moving from single-instrument automation to more complex lab-scale automation systems using sophisticated robotics to move, analyze, and route samples in real time. Intel® Core™ processors and Intel Atom® processors are used in these instruments and robotic systems because of specific capabilities, including a broad range of performance and power envelopes, more hardware-enhanced security, long-life support, and remote out-of-band manageability.

Next-generation automated instruments are increasing the use of computer vision inside the instrument to set the foundation for more improved remote diagnostics and the use of AI. Employing a computer vision system can:

1. Provide remote technicians with a view inside the instrument to shorten the time required to bring instruments back online after going down
2. Help prevent downtime with AI algorithms able to predict potential issues before they occur

Intel provides a portfolio of technologies for computer vision systems, including specialized processors, cameras, and software (e.g., Intel® Distribution of OpenVINO™ toolkit). These solutions are designed to optimize computer vision processing and AI algorithms for real-time uses in instrument and robotics applications.

The Intel focus fits within a larger early trend of clinical labs moving from traditional business intelligence to more advanced data analytics, including predictive analytics and AI.

Intel technologies power analytics and AI

Intel technologies support the shift in clinical labs to the use of more-advanced data analytics to optimize laboratory performance. Intel® Xeon® processors in local data centers can support a wide range of big data environments, and the Intel-based hyperconverged hybrid cloud infrastructure enables seamless processing of data between the lab and the cloud.

As laboratories move toward more predictive analytics (and eventually AI), they can take advantage of Intel Xeon platform capabilities, including Intel® Deep Learning Boost, along with a range of AI frameworks (e.g., TensorFlow) that are optimized for Intel® architecture to power the most advanced algorithms.⁴ In the future, clinical labs could use AI to support autonomous

workflows that route samples through the correct cascade of tests based on real-time analysis. This would free up time for lab staff and clinicians to focus on higher-level work and more complex cases.

Looking further out, increased demands for diagnostic testing along with rapidly advancing point-of-care diagnostic systems may drive dramatic changes in how the clinical laboratory operates. Labs may adopt more of a hub-and-spoke model with a larger portion of testing delivered at the point of care. Core labs would be reserved for more complex testing, such as genomics, complex cases, and population-level data aggregation and analysis.

Research laboratories are driving AI innovation

Today's advanced research laboratories are centers of excellence in the use of automation, big data analytics, HPC, and AI to unlock scientific breakthroughs. In pharmaceutical research, automation and HPC are shortening the time it takes to identify new therapies. These technologies enable researchers to analyze genomics data to identify potential drug targets and then screen large libraries of potential drug candidates against those targets.⁵ Agricultural and food labs are leveraging multiple data sets, including genomics and synthetic chemistry, to find innovative methods for meeting global food demand.⁶

HPC systems based on Intel® Xeon® Scalable processors can take advantage of unique technologies like Intel® Ultra Path Interconnect (Intel® UPI) to provide a scalable balance between computation throughput and energy efficiency, meeting the needs of both scientists and IT. Intel-optimized software toolkits such as the Intel® oneAPI Math Kernel Library (Intel® oneMKL) and Intel® MPI Library optimize analytical functions and support multinode scaling to help further improve application performance and optimize total cost of ownership.

As research laboratories continue to increase the use of data for simulation and experimentation, the size of available data sets becomes important to unlocking the next breakthrough insight. One new approach that enables collaboration across stakeholders is federated learning. With federated learning, organizations can make data sets available for training new AI models in a way that does not expose the underlying data. Intel Xeon Scalable processors are equipped with a technology called Intel® Software Guard Extensions (Intel® SGX) that more securely contains AI models in a hardware enclave. This allows for more secure AI training in a third-party environment without exposing the underlying model.

One day, R&D labs will be able to leverage increased automation combined with cloud computing to operate on a more globally distributed platform. This will unlock the opportunity to leverage more-advanced AI systems that can not only analyze the data but also enact modifications to experiments in real time with high levels of scientific precision.

Such a future could free up researchers to run experiments at massive scale. Intel technologies for data analytics, automation, and virtualized deployment of applications from edge environments to cloud computing will be foundational to making that potential a reality.

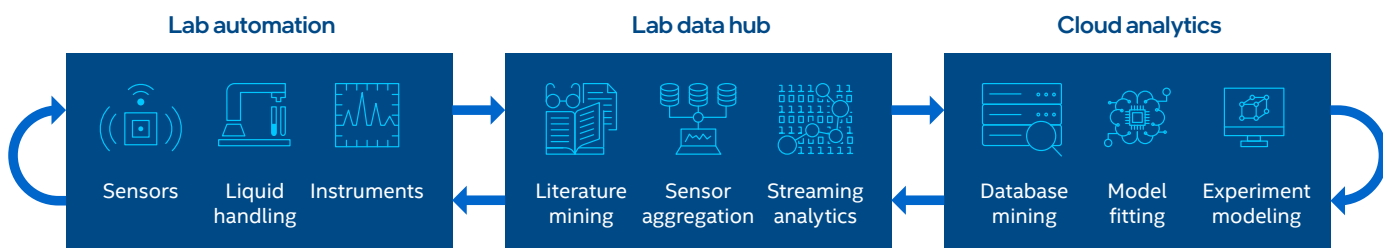


FIGURE 2: Specialized labs in various locations can use their equipment more efficiently without adding a great deal of infrastructure and without requiring movement of data.



Systems with Intel® Xeon® Scalable processors feature Intel® Ultra Path Interconnect (Intel® UPI) to help improve inter-CPU bandwidth for I/O-intensive workloads and offer a balance between computation throughput and energy efficiency.

Advancing the speed and effectiveness of scientific discovery

The clinical and research labs of the future will increasingly use AI to be faster, more efficient, and more data driven. By marshaling its industry-leading hardware and software portfolio, Intel is helping empower labs to achieve the speed, security, workflow optimization, and new insights necessary to unleash the transformative power of science.



Learn more about how Intel technologies are helping create the lab of the future

Life sciences technology: intel.com/healthcare

Intel Distribution of OpenVINO toolkit: intel.com/openvino



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