CASE STUDY

Enterprise
Artificial Intelligence

Improving Stroke Care and More With AI-Aided Medical Imaging

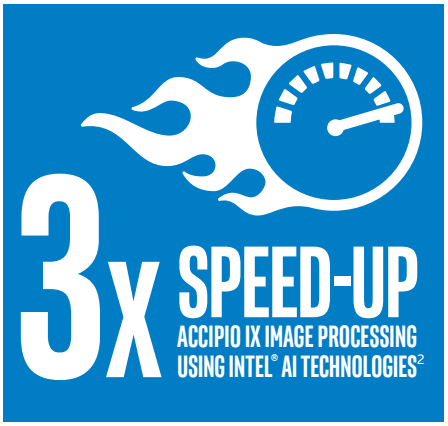
Capital Health uses AI technologies from MaxQ AI and Intel to augment radiologists' workflow, helping speed diagnosis and optimize care for brain-injured patients

maxQ® Artificial Intelligence

At a Glance:

Capital Health is using artificial intelligence (AI) to analyze brain scans and optimize care for patients with time-sensitive and life-threatening conditions.

- MaxQ AI's Accipio Ix helps physicians make fast, accurate diagnostic decisions. The solution has spotted subtle signs of hemorrhage that were missed by a first-pass reading.
- Intel® AI technologies shortened Accipio's computational workflow from 4.1 minutes to 1.4 minutes, delivering quick results to busy physicians.[2]



Every nine seconds, someone in the United States experiences a brain injury—and their life may depend on rapid, accurate diagnosis and effective treatment.[1] Capital Health is using MaxQ AI's ACCIPIO medical diagnostics solution, running on AI technologies from Intel, to help patients with stroke, traumatic brain injury (TBI), or other causes of a brain hemorrhage get the care they need when they need it. Working with the Intel® AI Builders program, MaxQ AI increased the computational performance of its Accipio Ix pipeline by 3x, enabling rapid analysis of CT brain scans.[2]

Challenge

As a Level II regional trauma center with a focus on stroke and TBI, Capital Health is eager to leverage AI to improve patient care. Their initial target: empowering increasingly strained radiologists with a fast, efficient workflow for brain hemorrhage diagnosis.

Solution

Capital Health deployed MaxQ AI's Accipio Ix deep-learning diagnostics solution within the radiology network. The Intel® Distribution of OpenVINO™ toolkit and other Intel® software libraries were used to optimize the solution, which runs on Intel® Core™ i7 processors, for maximum performance and flexibility at the network edge.

Results

With Accipio's AI solution providing a triage of CT scans, treatment teams can proceed with greater confidence in their diagnoses. The solution can flag exams with subtle signs of intracranial hemorrhage (ICH) and provide near real-time access to Accipio results, helping Capital Health to keep pace with their stroke center's commitment to read and report on CT scans within seven minutes.

> "ACCIPIO doesn't replace radiologists, because we're much more than just pixel detectors. ACCIPIO is an adjunct to us as radiologists. Even for experts who are highly sensitive to spotting anomalies, it augments our skills. That makes life better for patients."
>
> —Ajay Choudhri, MD, System Chair of Radiology, Capital Health

Spotlight on Capital Health

Capital Health is an award-winning regional healthcare leader that provides progressive, quality patient care with significant investments in physicians, nurses, and staff, as well as advanced technology. Capital Health includes two hospitals, an outpatient facility, and various primary and specialty care facilities across central New Jersey and Lower Bucks County, PA. Capital Health includes a Level II trauma center and a comprehensive stroke center at Capital Health Regional Medical Center in Trenton, and a neuroscience institute and cancer center at Capital Health Medical Center in Hopewell. It receives stroke and neurology transfer patients from a catchment area of 1.5 million people.

For more information, visit **capitalhealth.org**.

Using AI to Tackle a Crisis

Strokes are the fifth leading cause of death in the United States and the second leading cause around the world.[3,4] In the United States, each year 2.8 million people sustain a TBI, and 50,000 die as a result.[5] Timely diagnosis and treatment are crucial, in part because brain damage grows as a stroke or brain hemorrhage continues. Yet stroke patients are misdiagnosed in emergency rooms between 9 and 30 percent of the time.[6]

Even when an ER physician suspects a stroke or TBI and orders a CT scan of the patient's brain, the individual reading the results may lack the specialized skills to quickly detect subtle signs of bleeding in the brain. And even when scan results are interpreted by highly skilled neuroradiologists, these professionals are taxed by expanding workloads. With new imaging technologies producing higher numbers of ever-more finely sliced images, the field of radiology is reaching a crisis point, according to Dr. Ajay Choudhri, system chair of radiology at Capital Health and chairman and medical director at Capital Health Advanced Imaging PC.

"The temporal and spatial resolutions of scans have gotten so good that radiologists are asked to read many more images than ever before," Dr. Choudhri said. "You try to look at each slice, because you might catch something you would otherwise miss. There's so much data, it has become a crisis for radiology."

Make Great Care Even Better

New Jersey-based Capital Health is already a highly ranked institution with comprehensive facilities for stroke, neuroscience, and acute trauma care. Now, it is using AI to raise the bar on workflow excellence for stroke and TBI. Capital Health is deploying MaxQ's Accipio Ix and Intel® AI technologies to prioritize patients with even subtle signs of a brain hemorrhage. Capital Health's goal: ensure that every patient with a stroke or head injury gets a fast, accurate diagnosis at a time when minutes matter.

Capital Health needed an AI solution that would be fast as well as accurate. Capital Health's stroke center has an internal quality target to read and report on CT brain scans within seven minutes, according to Dr. Choudhri. "We are tasked as radiologists to be very speedy with our results, and we are very, very, very impatient," he said. "Having a tool that gives us identification and prioritization is very welcome. It heightens our awareness to acute findings, but it has to be instantly available. Having the results 20 or 30 minutes later is not going to be useful."

AI in the Clinical Workflow

Accipio Ix is part of MaxQ AI's Accipio Intracranial Hemorrhage (ICH) platform, a comprehensive, automated solution for assessing head trauma and stroke, designed for use by health professionals in emergency rooms, radiology departments, and neuroradiology organizations (see Figure 1). Using computer vision and machine-learning models, Accipio Ix analyzes CT images and highlights possible brain hemorrhages by running model inference on Intel® processors.

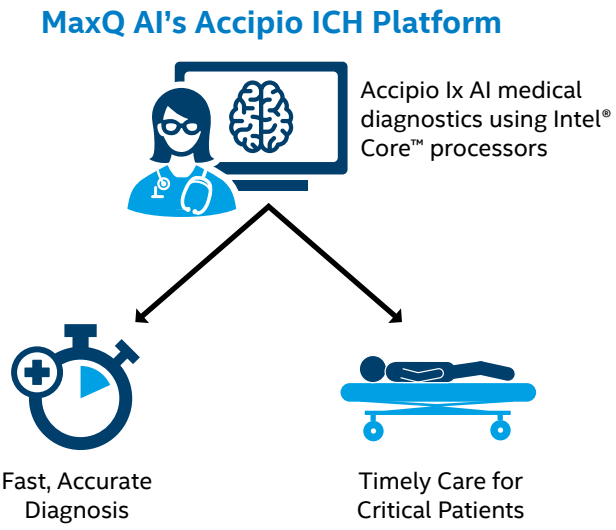


Figure 1. MaxQ AI's Accipio Ix runs on Intel® AI technologies and supports rapid, accurate diagnosis and timely care for patients with a possible brain injury.

Capital Health is using an Intel Core i7 processor-based Accipio appliance to analyze all CT brain scans performed across its health network—approximately 1,000 image studies per month, each with hundreds of image slices. The appliance handles six brain CT scan machines at Capital Health, plus one in its specially equipped stroke ambulance.

When a CT scan completes, the diagnostic equipment routes the results to the appliance and to Capital Health's on-premise picture archiving and communications systems (PACS). The Accipio analysis is fast enough that its results are already in the system when the radiologist opens the image study. Radiologists can review both sets of data before sharing their conclusions with the neurology team to inform their treatment planning.

Dr. Choudhri, who views thousands of slices per day, has incorporated Accipio into his daily routines and says it makes him more confident that he has analyzed the images correctly. "Accipio has become second nature," he said.

Capital Health tested Accipio's accuracy on a CT exam where the institution's quality process had identified small brain hemorrhages that the initial human read had missed. In this case, Accipio Ix detected the hemorrhage in a retrospective analysis.

Fast Answers with AI on Intel

To handle the demands of the acute care environment, MaxQ AI chose Intel AI technologies for cost-effective performance in a flexible and easily managed platform. The company's machine-learning experts optimized the solution's performance by working with the Intel® AI Builders program, which brings together a range of companies and organizations committed to fulfilling the potential of AI. The collaboration paid off.

MaxQ AI's optimizations produced a 3x improvement in the image processing time for Accipio Ix without compromising accuracy, according to Steve Kohlmyer, vice president of research and clinical collaborations at MaxQ AI.[7] "The original product release of Accipio Ix took an average of 4.1 minutes to process a radiology exam," he said. "The average processing time for the first 4,000 exams at Capital Health has been 1.4 minutes. That improvement reflects the optimization we did through the Intel AI Builders partnership."

MaxQ AI has taken advantage of a broad range of Intel® tools and technologies. It uses the Intel® Math Kernel Library for Distributed Neural Networks (Intel® MKL-DNN) to fine-tune model performance on Intel processors. MaxQ AI also deploys the Intel Distribution of OpenVINO toolkit to speed up image recognition applications on Intel® architecture-based platforms.

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>
> **—Steve Kohlmyer**
> VP, Research and Clinical Collaborations, MaxQ AI

Better for Patients

While the Accipio platform is delivering clear value at Capital Health, Dr. Choudhri expects AI to have an even greater impact in areas where expert radiologists are in short supply. "At Capital Health, our neuroradiologists are very accurate and highly sensitive to subtleties in the images, but that is not always the case in community hospitals," he said. "There is definitely a role for heightening the sensitivity with an algorithm."

Dr. Choudhri is excited about AI's future in diagnostic radiology—and its ability to augment radiologists. "Within a few years, we'll be at a point where a radiologist using AI will consistently be better than a radiologist without AI," he said. "ACCIPIO doesn't replace radiologists, because we're much more than just pixel detectors. ACCIPIO is an adjunct to us as radiologists. Even for experts who are highly sensitive to spotting anomalies, it augments our skills. That makes life better for patients."

The bottom line? "Machine-learning tools are coming," said Dr. Choudhri. "We should use them to best effect to enhance our ability to deliver care."

Find the solution that is right for your organization. Contact your Intel representative or visit **intel.com/ai.**

Solution Provider: MaxQ AI

MaxQ AI is a medical diagnostic AI company with a mission to reduce misdiagnosis and healthcare costs by making AI intrinsic to the diagnostic process for time-sensitive and life-threatening conditions. Based in Israel and Massachusetts, MaxQ AI uses machine learning and machine vision technologies to interpret medical images and surrounding patient data. Stroke and traumatic brain injury are two areas where MaxQ AI has initially focused. The company's AI's Accipio platform can be integrated into PACS, medical imaging hardware, and healthcare clouds. Accipio Ix has received both FDA clearance and CE Mark certification and is being deployed through major OEM CT and PACS partners.

For more information, visit **maxqai.com**.

Learn More

You may also find the following resources useful:

- Intel AI Technologies
- Intel AI Builders Program
- MaxQ AI
- Capital Health

[1] The Art of Medicine Foundation, January 30, 2019. "Every nine seconds, someone in the United States sustains a brain injury." artofmedicinegala.org/every-nine-seconds-someone-in-the-united-states-sustains-a-brain-injury

[2] Testing conducted January 2019 by MaxQ AI produced 3x performance increase over baseline. Configuration: 1 socket Intel® Core™ i9-7960X processor, 16 cores per socket, OS Microsoft Windows Server 2016 Standard, Kernel 10.0.14393 Build 14393, Total memory 64 GB, SMBIOS Version 3.0. Optimized: Testing conducted on January 2019, 1 socket Intel Core i9-7960X processor, 16 cores per socket, OS Microsoft Windows Server 2016 Standard, Kernel 10.0.14393 Build 14393, Total memory 64 GB, SMBIOS Version 3.0, Python 3.4, Caffe2 0.8.0 (stock), VTune™ 2019 Update 1, OpenVINO™ SDK v3.34.

[3] Centers for Disease Control and Prevention, "Stroke." cdc.gov/stroke/index.htm

[4] World Health Organization, May 24, 2018. "The Top 10 Causes of Death." who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

[5] Taylor CA, Bell JM, et al, April 27, 2017. "Traumatic Brain Injury-Related Emergency Department Visits, Hospitalizations, and Deaths, United States, 2008 and 2013," cited at Brainline, Get the Stats on Traumatic Brain Injury in the United States: Centers for Disease and Prevention. brainline.org/article/get-stats-traumatic-brain-injury-united-states

[6] MaxQ AI, February 13, 2019. "MaxQ Accelerates Artificial Intelligence Performance with Intel." maxq.ai/2019/02/13/maxq-accelerates-artificial-intelligence-performance-with-intel

[7] See footnote 2.

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