Cover Story:

COVID-19 Management
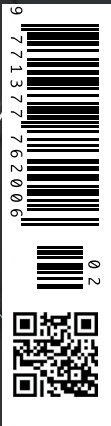
Think Inside The Box: This Parisian Hospital Has a Dedicated CT Cabin for its COVID-19 Patients

A prefabricated cabin has sprung up just outside the entrance of the giant Henri-Mondor hospital in Créteil, a commune in the southeastern suburbs of Paris. The unassuming module might look like a trailer home or the temporary office for a construction project, but it's actually a vital outpost in the hospital's battle against COVID-19.

Nestled inside the specially designed 36-square-meter module is a brand-new computed tomography (CT) scanner, a tubular machine that combines X-rays with computer processing to build a precise picture of the inside of a human body. The whole setup, which bolsters the hospital's imaging arsenal without occupying any of its precious indoor floor space, has been dubbed "CT in a box"1 by the GE Healthcare engineers who invented it.

The extra machine will aid Hospital Henri-Mondor in assessing disease progression and complications in COVID-19 patients while also smoothing patient flow across the facility. That's because the module is entirely dedicated to COVID-19 patients, says François Meignan, a project manager at GE Healthcare who designed the project. "It's not just about patient numbers — it creates a specific flow for them."

GE first deployed the technology in China and the United Arab Emirates. "At the beginning of the outbreak, China's clinicians in remote or pop-up hospitals quickly called for the precise images CT scans provide to help them spot complications earlier," Kieran Murphy, GE Healthcare CEO, wrote in an opinion piece published in Barron's. "To address this need, our engineers quickly developed CT-in-a-box, an easy to install modular machine that captures the same robust imagery of traditionally installed CT scanners. Learning from our experience there, GE Healthcare teams in France developed a similar solution to address the urgent need for additional imaging capacity — and specifically adapted it to the needs of clinicians caring for COVID-19 patients."

The French hospital already had plans to beef up its intensive care bed capacity several months before the coronavirus pandemic, but the rapid spread of the infection

Image: Courtesy of GE Healthcare

Top: François Meignan, a project manager at GE Healthcare, designed the "CT in a box" (above) for Paris-area hospital Henri-Mondor. When the facility urgently needed more imaging capacity for COVID-19 patients, Meignan's team brought the on-demand solution from concept to completion in just two weeks.
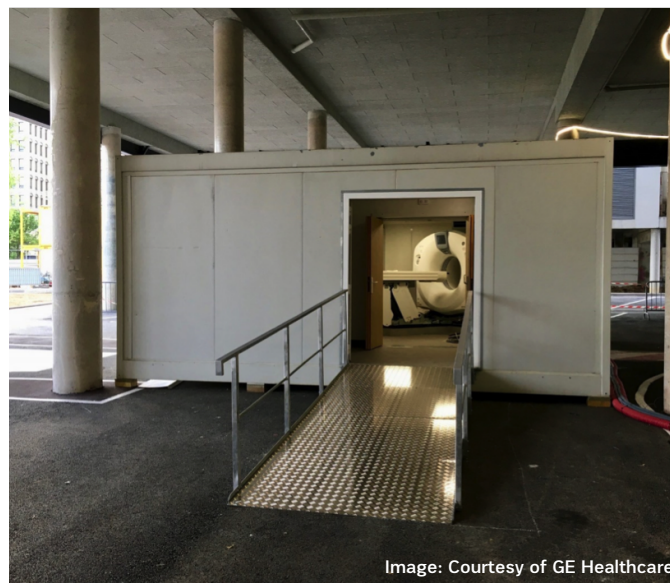

Image: Courtesy of GE Healthcare

accelerated its plans. In late March, hospital authorities decided to nearly double the facility's ICU capacity from 90 to 175 beds. "Our three CTs were already fully busy, [so we thought] how can we create a fourth one?" says Alain Luciani, radiologist and medical head of Academic & Medical Department FIxIT. "We turned to GE Healthcare and said 'OK, how can you help us?'"

Brainstorming began immediately; it had to. "The opening of the new building was already planned for 9 April, so we had to find a solution — concept and build — in two weeks," explains Meignan, a project manager who works at GE Healthcare in the north of France. "They [the hospital] wanted an easy-to-install solution, fast in concept, and fast in building, so we worked on drawings to find a solution," says Meignan.

The team soon discovered that designing this CT in a box required some out-of-the-box thinking. The sticking point was not fitting the CT machine itself in a trailer, but replicating the safe, controlled and easily accessible environment of a hospital CT room. A quick primer: CT machines rely on electrically produced radiation to image anatomy. The donut-shaped gantry houses both the X-ray tube and detectors positioned on opposite sides of the ring. As the gantry rotates, it produces cross-sectional, or tomographic, images of the areas of the human body within the donut hole. "It takes pictures in slices, creating a 3D model to detect anomalies," explains Meignan.

The small dose of radiation emitted by a CT scan may be low-risk to the patient, but imaging technicians repeat the procedure several times per day. That is why CTs always have lead-shielded walls and thick windows between the exam room and control room, where technicians and clinicians can observe the patient and perform the imaging process. It's also why the exam room and control room each have their own doors.

CT scan rooms also use sophisticated heating, ventilation and air conditioning (HVAC) systems to maintain a constant temperature of around 72 degrees Fahrenheit. The exam room is prone to increasing temperatures because the gantry's electronics expel plenty of heat.

Inspired by the CT-in-a-box solutions their GE Healthcare colleagues had developed for China's remote and pop-up hospitals, Meignan and his team designed their own modules, drawing materials from local supply chains. Of course, they knew they'd need much more than a big trailer and a power supply. "We had to find a place outside to create an exam room with specificities like electrical supply, HVAC and shielding," Meignan says.

Image: Courtesy of GE Healthcare

Jerome Duhamel, the healthcare project management leader for GE Healthcare in Europe, says 18 such modules will be sent to the U.K.'s National Health Service in coming weeks.
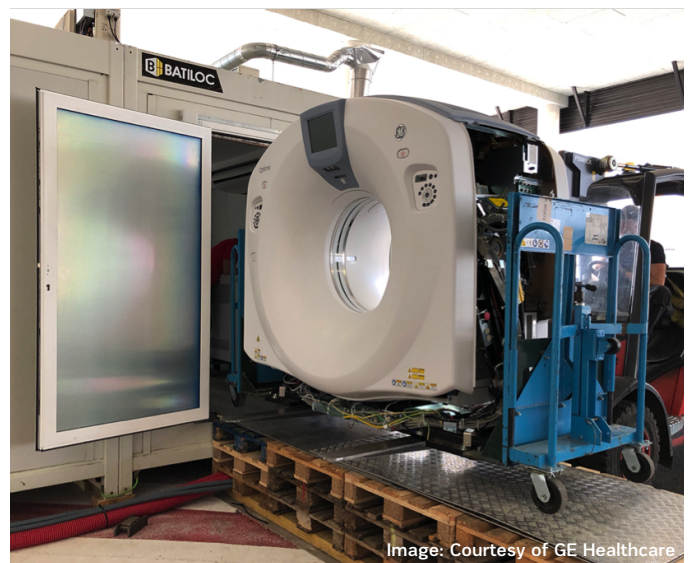

Image: Courtesy of GE Healthcare

With the two-room housing in place, the CT scanner itself is forklifted into the module's dedicated exam room.

They settled on a design consisting of two small, prefabricated cabins joined into a single, square module with a shielded partition wall between the exam and control rooms. While there would be no windows, technicians in the control room would monitor real-time webcam images of the exam room via TV screens. The module would have an HVAC unit to maintain its temperature, and there would a door for each room, separated at opposite ends.

Image: Courtesy of GE Healthcare

"Onsite, you just put together the two boxes, plug in the cable and that's it," Meignan says. After a couple days of machine calibration, Créteil's CT in a box was ready to scan its first patients.

Image: Courtesy of GE Healthcare

Maxime Huet, a project manager of the installation.

The next step was to determine whether all the materials were available in northern France: The whole country had begun a strict lockdown on March 17. But GE Healthcare partner Ramery Energies and its suppliers came through. "They worked day and night so we could finish the module as soon as possible," says Meignan.

Post-assembly, GE Healthcare's team ensured the box was battle-ready before it departed for Paris. "HVAC was checked, the shielding was finished, and the power distribution was already installed," says Meignan. A truck then hauled the module's two pieces to the hospital, where a

small crane lowered them into place. A forklift then hoisted the two main parts of the CT machine — the hulking gantry and the long, flat table — into the module. Finally, workers laid a metal ramp up to the cabin, allowing patients to be wheeled out the hospital doors and directly up alongside the CT scanner.

The whole setup looks similar to mobile blood banks that erected in parking garages or the medical cabins at rock festivals.

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Including the exam table, the GE Healthcare-manufactured machine, which is part of the Optima CT family, tips the scale at 2.5 tons. "It's a big and heavy machine, so we needed reinforcement inside the module," says Meignan. But it is worth its weight in gold: The clinical consensus is that CT scans are an important imaging modality for assessing disease progression and complications in COVID-19 patients. "Patients are very fragile in terms of their respiratory condition, and they face different complications — and CT is there to detect those complications," explains Luciani, the Albert Chenevier-Henri-Mondor doctor.

While the scan itself be completed in a matter of minutes — or even seconds — technicians can accommodate around one patient per hour, due to the time needed to prep the patient and fully sanitize the exam room. But, as Meignan explains, the new module is not just about boosting the number of scans, but smoothing patient flow across the entire hospital. That is because the module will relieve pressure on the facility's three existing CT machines and because it is located near the hospital's ICUs, where it treats its COVID-19 patients.

It might just be the beginning for the CT-in-a-box concept in Europe. Jerome Duhamel, the healthcare project management leader for GE Healthcare in Europe, says 18 such modules will be sent to the U.K.'s National Health Service in coming weeks.

In the meantime, it's all systems go in Créteil. "We are ready to go, 10 days after [reaching out to GE Healthcare]" says Luciani. "It was an adventure for us, for GE Healthcare and for the workers who worked night and day to build those containers." ∎

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¹Availability is subject to local supply capacity and requirements that vary by country. Contact a GE Healthcare representative for more information