

Dear Friends,

When I entered the COVID ICU yesterday morning it was in a state of pandemonium. Nurses scurried along the aisle between the two long rows of patients and each bedside scene pulsated with barely contained panic. Here was a doctor using a bag to squeeze air into a patient beside a stalled mechanical ventilator. At another a nurse dangled an oxygen line in front of a patient's nose. At another a relative stood fanning air towards his patient's open oxygen helmet, while a woman at the next bed desperately massaged her husband's legs. The usual beeps of alarms had multiplied to a screaming chorus.

"What's going on here?" I asked the doctor squeezing the bag.

"The central oxygen's been off for the last ten minutes!" he hollered. "This is the fourth time!"

I looked down the line for a patient without an attendant. There were sixteen patients in the ICU, ten supposed to be on ventilators and the rest on other high-flow oxygen devices. Meena was a 56-year old patient with henna-dyed hair who'd somehow managed to give me a smiling namaste each day on rounds. Now her "helmet" oxygen device sat flaccidly on her head, its 'hatch' open to the air, her face flickering fear.

"Don't worry, Meena, don't worry, the oxygen will come back," I offered tenuous reassurance before going off to search for a spare oxygen cylinder to lug back to her. On bedside monitors patients' blood oxygen saturations read 38, 62, 34, 28, 49, 75 and plummeting – dangerously below the acceptable 90%.

Then, in a voice tinged with as much anxiety as relief, someone shouted "It's come back!" We re-attached patients to their support devices and the monitor numbers promptly began to climb.

Nepal's first COVID surge hit us in September. While it was rocky at times, the Patan Hospital COVID census peaked at 140 patients, which turned out to be manageable. In the meantime, knowing the pandemic had entered countries in successive waves and with less than 2% of Nepal's population fully vaccinated, we expected a second surge. The hospital ordered a new oxygen plant to replace the old one, deemed beyond repair, and went on using portable cylinders connected to a hospital pipe grid with single cylinders distributed around the hospital. Considering India's recent calamity, twelve days ago the Nepal government ordered a lockdown.

We don't know what variants have entered Nepal, but over the last month the disease here appears to spread more rapidly and take a more severe toll on the middle-aged than during the first surge. Coronavirus can ravage the lungs, leaving the worst-affected patients in a state of unrelenting air hunger. Although there are several marginally-effective drug treatments, the foundation of COVID care is simply to provide lots of supplemental oxygen for as long as needed.

Last night, despite subsequent oxygen stoppages, all the patients in the ICU survived and our junior doctors even managed to move two patients off their ventilators and onto lower levels of oxygen support. This morning we met as a medical team and made oxygen conservation plans. The four teams rounding in 'COVID' today were to turn down all oxygen flow so as to keep patients at no more than 90% saturation (we usually aim for over 94%).

The hospital's oxygen 'manifold' station sits beneath a slanting corrugated roof between the maintenance department's workshop and a narrow road bordered by broken trolleys and fragments of discarded furniture. The station consists of a long horizontal pipe suspended six feet off the ground from which, at one-foot intervals, copper pipe tendrils spiral down with attachments for cylinders. Twenty four of these connectors hang along a line extending to the left of a control box and twenty four more to the right.

When I arrived there, four men from the maintenance department were looking at the dials of the blue control box from which three red lights shone.

"Thirty minutes. Forty five at most. That's all the oxygen left down here."

"You mean, there are *no* other cylinders?"

"No. Not one. This is it. The very last," said Dhruba, who wore a Nike hat with brim pulled low, motioning along the line to the right, "When these twenty finish, the hospital flow stops."

As we stood waiting, their comments verged on gallows humor, but their faces betrayed worry. They glanced between their watches and the pressure dial.

Then Dhruba's phone rang and he announced flatly "Truck's come. Get ready."

With that the four swung into action, disconnecting empty cylinders along the left line of the manifold to make way for the batch coming on the truck. The cylinders were painted gray or brown, flecked with rust, with white numbers scrawled around their tops. Each was 5 feet high and weighed 60 kg (130 pounds).

When the hospital's dusty, gray pick-up truck pulled up, three men jumped out to begin tipping full cylinders off its tailgate. Each landed like a gong and someone rushed to spin-walk it across to the station

and screw it into a dangling connector. Within five minutes the monitor's dial showed a nearly full system and the collecting pipe emitted a continuous 'twing,' indicating oxygen was gushing into the needy hospital. Unseen in the depths of the sprawling medical complex, they'd managed to preserve flow to the ports of roughly one hundred serious patients, including in the ICU.

"These will last just two hours. No more. They didn't have time to fill the bottles completely." One man split from the group saying he'd not eaten while the other two immediately drove off in the truck to pick up the next apportionment of oxygen.

Of all the examples of leadership I've witnessed over my career, Patan Hospital's response to this pandemic is exceptional. In a 700-bed hospital receiving only modest government funding and previously caring for 350,000 patients a year, management has created a central block dedicated to COVID care. This meant erecting barriers in each of the four floors to cordon off sections which could be entered only in PPE. Supply lines of medicine, equipment, food, drinking water, and oxygen course into this isolation bubble, with a single freight elevator linking the floors. Although many hospital staff have tested positive, not one has become seriously ill and all are now fully vaccinated.

Outside the canteen, Dr. Paras Acharya was pacing on the sidewalk talking loudly into his cellphone while Dr. Rajesh Gongal stood to the side. Paras, the Registrar, is a tall man around fifty with gray-streaked hair and a manner some in the hospital call 'dashing.' Rajesh, the overall head of the institution, is short and balding with delicate features and a reserved manner. He chuckles even when he's not pleased, which he was not when I walked up today.

"We've got a meeting now with the Health Ministry," Paras announced. "They *have* to take this matter into their own hands. Oxygen's being purchased at plants by every Tom, Dick and Harry, while we hospitals are left high and dry. Individuals are just snapping it up. The army has to take control."

According to Paras, the new plant ordered from Slovakia will not be in Nepal and functional for another month. Until then the hospital's patients will be dependent on the cylinder-ferrying system, which in normal times supplies just over 100 cylinders per day, enough to comfortably cover hospital needs. The current COVID demand is nearly 400 per day and outside oxygen plants who'd promised Patan regular supply have reneged.

The half mile road to the Patan Industrial Estate is usually packed to the brim with buses, cars, and minivans but today it was deserted except for a cluster of military men standing idly with guns. Off a back road under a purple jacaranda tree stood the barn-like buildings of *Sagarmatha Oxygen Pvt. Ltd.* Six pick-up trucks, including Patan Hospital's, were parked at all angles, spilling out of the plant courtyard into the road. At one end of the plant two turbines roared. In the cavernous space at the other end hundreds of empty cylinders stood like a terra cotta army waiting their turn at the 29-head fill-up station. Working around the clock as it has over the last week, with six or seven men continuously shifting cylinders, the plant can supply 800 cylinders a day. It's one of eleven plants in the Kathmandu valley. The trucks waiting in line were from hospitals located in different corners of the valley. The Patan Hospital driver looked at his watch and shrugged, wondering if he'd be able to get refills back to the hospital in time. The hectic routine of the last three days was steadily eroding any sense of optimism.

When I returned to the nurses' station outside the COVID ward, Gyani the nurse in charge reported there'd been no more stoppages of oxygen that morning. And no deaths.

"Patients are afraid, though. Some have left the hospital to look for private hospitals where they think the oxygen will be more reliable. Four visitors to the ICU patients have arranged cylinders on their own and brought them to their bedsides as back-up. So much tension."

"I want you to know I think your nurses in there are doing heroic work."

It's hard to say where this ends – a hospital taking in batches of oxygen cylinders like a patient drawing her last breaths, not knowing when the flow next breaks. The hospital has now closed to new COVID admissions, which will limit the internal demand, but by all indications Kathmandu is full of hospitals whose collective oxygen consumption has swelled beyond the valley's production capacity.

Today wasn't my day to make rounds and others have administrative responsibility for the hospital, so I went and found a quiet alcove behind physiotherapy to sit and pray for a while. Please join me. I think that's the best way to help in this situation. Thank you.

Love,

Mark and Deirdre, (Zachary and Benjamin – both in the U.S.)