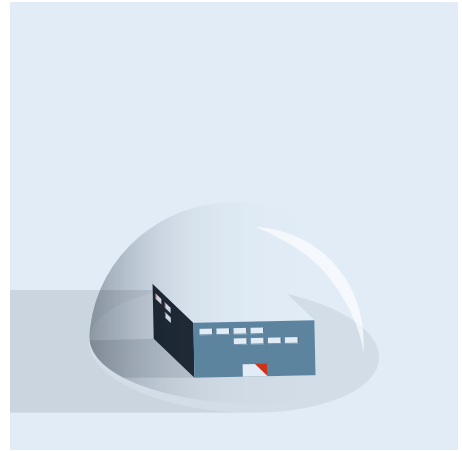# RETHINKING HEALTHCARE FOR A PANDEMIC AGE

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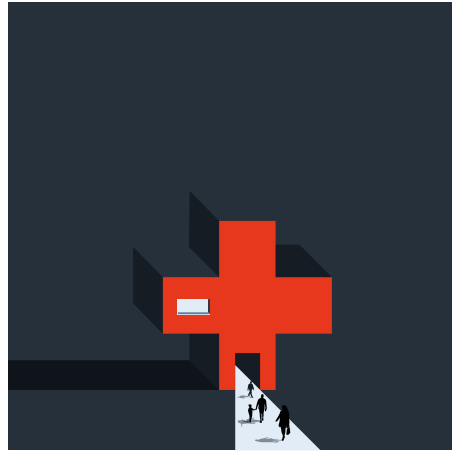
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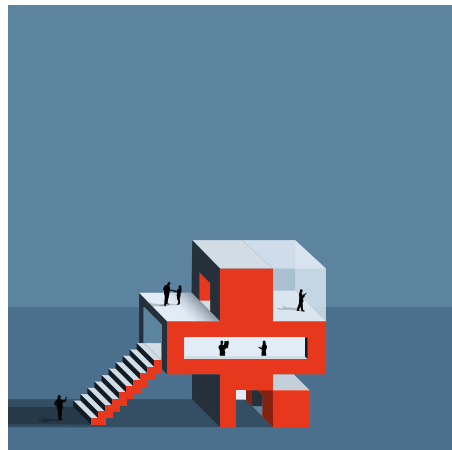
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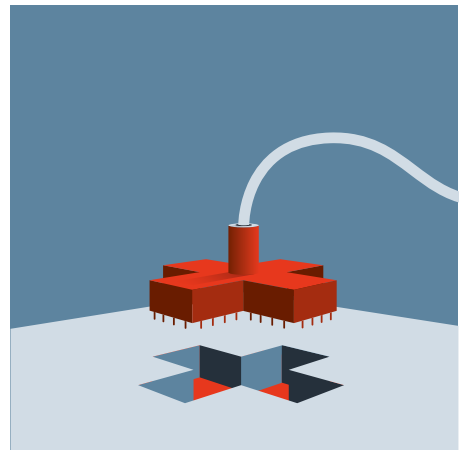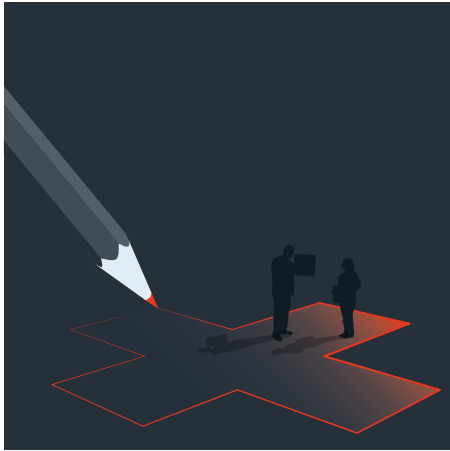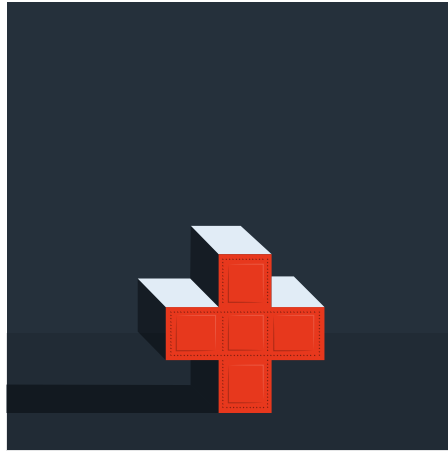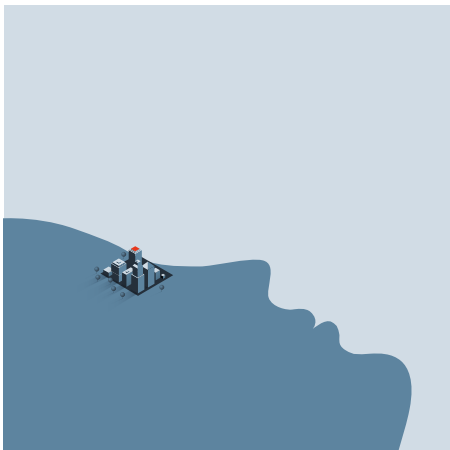
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FOREWORD

Healthcare after COVID-19: Lessons for resilience

Even before COVID-19, the global healthcare sector was the scene of great ingenuity, superhuman feats and extraordinary dedication. The pandemic has seen it go above and beyond, and unleashed innovation on an unprecedented scale. Now we need to decide what to take forward from this tumultuous period, and how we can integrate it into a new, better normal for healthcare.

Looking back to the start of the pandemic is not about filing it away for posterity, applying 20:20 hindsight and apportioning praise or blame. It is vitally important that we apply these hard-won lessons to inform our coping strategies in the face of more frequent epidemics, antibiotic resistance and the impacts of climate change. We need to make healthcare buildings more readily adaptable, and healthcare systems more resilient, and we need to use technology to support and nurture the caregivers who are their lifeblood. We also need to strengthen the links between healthcare and health-creating activities, and address the ways that cities contribute to poor health.

WSP's global engineering and advisory teams have been working alongside our clients on the immediate response to COVID-19, and on transitioning facilities for the longer term. In this series of articles, we have begun to explore some of the pressing questions that the pandemic raises for the sector — we look forward to continuing these important conversations over the months and years to come. ●

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WHAT HAS COVID-19 TAUGHT US ABOUT HEALTHCARE DELIVERY?

COVID-19 has provided a new lens through which to view how healthcare is delivered, and what it is possible to achieve. How can we use these insights to emerge stronger from this crisis?

We knew a healthcare crisis was looming. But this wasn't the crisis we were expecting.

Until COVID-19 began its inexorable global spread, the greatest threat to the world's healthcare systems seemed to be the rise of noncommunicable diseases (NCDs) such as heart disease, cancer, diabetes and chronic respiratory disease, combined with an ageing population. We knew that these conditions were already responsible for 70% of global deaths and that the worst was yet to come — a report by the World Economic Forum and the Harvard School of Public Health predicted that NCDs would cost the global economy more than US$30 trillion between 2010 and 2030, a substantial burden evolving into a staggering one.

We knew too that the risk of epidemics and pandemics had increased with globalization, urbanization and climate change, and that growing antimicrobial resistance could plunge us back into a terrifying pre-antibiotic era.

COVID-19 must be the priority now, but none of these other challenges have gone away. The pandemic has lengthened waiting lists as it delayed testing and treatments — more than 28 million elective operations will be cancelled or postponed worldwide during 2020, according to a projection by the CovidSurg Collaborative, published in the British Journal of Surgery. What it has given us is a once-in-a-generation opportunity to rethink how services could be delivered and what it is possible to achieve. So what can we take from this crisis to help the world's healthcare systems perform better over the decades to come?

In this series of articles, WSP explores the lessons we can take from the COVID experience, and the challenges and potential solutions it presents — from re-engineering hospital environments, to resilience planning, to reshaping cities to support healthier, happier populations. But perhaps the most fundamental question is how healthcare should be delivered: what is the most effective way to improve outcomes when there will be ever-diminishing resources to go round?

Virtual care is here to stay

COVID has completely shaken up healthcare operations, emptying outpatient departments and doctors' waiting rooms, and virtualizing many activities overnight. Providers needed to make space for an influx of COVID patients; patients were too scared to seek care in-person. Both were forced to overcome their reservations about telehealth. In a matter of weeks, it went from little-used novelty to the mainstream, with consultations via telephone or video replacing visits.

Anecdotal evidence suggests that many have been pleasantly surprised, and that both patients and doctors would choose to continue using telehealth at least some of the time. In the UK, for example, the Royal College of General Practitioners says that the proportion of in-person to remote consultations has reversed since lockdown, with 70% of appointments now taking place via video or telephone. Post-COVID, it envisages that this will settle into a 50:50 split. "From an absolute reluctance to use IT, there's been a realization from clinicians that actually it is a reasonable method of communicating and engaging with patients," says Simon Kydd, WSP's head of healthcare in the UK. "I think the use of telemedicine will rocket in the next few years, and that will ultimately have an impact on hospital design as appointments reduce."

Virtual appointments improve access to care for remote populations, but they are also much more convenient for urban dwellers and physicians themselves, says Dr Stephen Duckett, who has held senior leadership positions in both the Australian and Canadian health systems and is now health program director at the

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Grattan Institute think tank in Melbourne. So far, he says, failure to attend appointments appears to be lower when patients don't have to actually go to a hospital. In some cases, follow-up appointments after surgery can be done just as well over telephone or video, while ongoing treatments such as chemotherapy or dialysis may take place in a "virtual ward" with clinical teams visiting. "For some people, being able to lie in their own bed with their family around them is better than having exactly the same treatment in a hospital," says Duckett. "The research evidence is pretty clear — rehabilitation at home is just as good." This is also safer for those whose immune systems are already weakened and vulnerable to hospital-acquired infections.

Duckett believes that telehealth should be expanded, but not in such a way that it undermines existing care. "If we think that good primary care for a person with chronic illness is continuity of care — which the evidence says that it is — then we have to make sure that telehealth fits into that system rather than cutting across it." Grattan Institute has published a set of recommendations for the Australian government, which include structuring payments and incentives so that telehealth providers must also offer face-to-face services, to ensure patients see their usual practitioner rather than a web-only doctor they have never met before. The first appointment should always be a face-to-face one.

There is of course the risk that telemedicine simply replaces one set of access issues — location, convenience — with another, namely those of age, poverty and connectivity. "We can't let the perfect be the enemy of the good," says Duckett. "You shouldn't stop improving access for the majority just because it doesn't fix the problem for everybody. If we decide telehealth is good, we then need to find the strategies to make sure that people don't fall behind."

There is a perception that it's older people who will be excluded from digital services, but plenty have become more familiar with technology during lockdown to stave off social isolation. The more intractable barrier is poverty. Low-income communities not only have the highest rates of chronic illness, they are also most likely to find themselves on the wrong side of the digital divide. This is a gap that the Howard University College of Medicine in Washington DC is trying to fill with an innovation project to develop telehealth solutions tailored to medically underserved populations. (Howard University associate dean Michael Crawford discussed this project in the most recent issue of WSP's *The Possible* magazine.) →

YOU SHOULDN'T STOP IMPROVING ACCESS FOR THE MAJORITY JUST BECAUSE IT DOESN'T FIX THE PROBLEM FOR EVERYBODY

DR STEPHEN DUCKETT,
GRATTAN INSTITUTE

→ COVID has also seen the expansion of in-patient telehealth, where physicians observe and communicate with patients from outside their room, using cameras, microphones and screens. Banner Health, an Arizona-based non-profit health system with 28 hospitals across six US states, had already installed a handful of these "eICU" systems, to give the most critically ill patients access to a wider range of specialties. When the pandemic struck, it installed hundreds more across its hospitals within just a few weeks. "That was for clinician safety and to decrease our PPE utilization — even if the doctor was in the hallway only 50 feet away from an infected patient, they were in a safer setting," says executive director of facilities services Steve Eiss. "Now we're starting to see doctors get more comfortable with treating people in that way." He thinks this will continue after COVID, but for reasons of efficiency and access. "We could have a cardiologist sitting in a centralized location seeing patients in three hospitals or 30 hospitals. They might spend three-quarters of their time seeing patients at the hospital they're in, and the rest being a rotating specialist for other facilities, either to save travel time or for access at more rural facilities."

A video consultation may feel like the future, but this is only the beginning of telemedicine's evolution. Princess Margaret Cancer Centre in

TELEMEDICINE HAS SHOWN SOME OF ITS POTENTIAL, BUT IT'S BEEN USED AS A BLUNT INSTRUMENT TO DATE. HOW CAN WE OFFER CONTINUOUS AND REAL-TIME CONNECTION WITH THE HEALTHCARE SYSTEM?

MIKE LOVAS, PRINCESS MARGARET CANCER CENTRE

Toronto, one of the world's best, has successfully virtualized around 75% of outpatient clinic visits since the start of the pandemic. Mike Lovas, the hospital's design director of Smart Cancer Care and Healthcare Human Factors, says they are now exploring how to extend the approach. "Telemedicine has shown some of its potential, but it's been used as a blunt instrument to date," he says. "How can we offer continuous and real-time connection with the healthcare system? After all, patients don't have concerns, symptoms, or deteriorate conveniently during pre-scheduled visits. Life happens between hospital visits, and outside of the hospital, and we need to embrace that."

One example is a nurse-led monitoring clinic where patients can submit symptoms or concerns to their care team, who respond in real-time via phone or secure messaging. Lovas says that the data captured during these encounters will feed algorithms to auto-recommend additional self-care education or services, and presents an opportunity to provide more remote care and weave hospital and community programmes together through auto-referrals to services such as sexual health or palliative care. "The data collected supplements the provider's memory of programmes that might serve the patient, and it will also help us create predictive analytics to refine the way we provide proactive care for similar patients in the future."

By extending care into patients' homes on a continuous basis, telemedicine also sets the stage for a more preventative approach and better management of chronic conditions. This will be essential if services are not to be overwhelmed as lifespans lengthen and the rate of noncommunicable diseases continues to rise. "Healthcare has typically been reactive and intermittent, but we are finally moving away from an ethos of illness to an ethos of wellness and continuous, proactive health," says Suzanne MacCormick, a clinical planner and previously global healthcare lead at WSP. "COVID has shone a light on the fact that healthcare permeates everything we do and transcends all sectors. It is not just about seeking help when we get sick, it's about how we keep people well in healthy, safe environments designed to enhance our wellbeing and quality of life."

Keeping hospitals only for the sick
But why are there so many people with chronic conditions in hospital in the first place? Before COVID, many were already questioning the use of acute facilities for so many services, and the

over-use of emergency departments for ailments that could be better dealt with in a primary-care setting. In response, there is a nascent shift of diagnostic or outpatient services to smaller, community hubs.

In the US, for example, providers are now incentivized to keep patients out of hospital where possible. Banner Health is building outpatient centres with a mix of services, from primary care to specialties such as cardiology and women's health, to imaging suites, laboratories for analyzing blood and an on-site pharmacy. "So you can go and see a primary care physician, and they could say, 'I noticed your heartbeat didn't sound right' and send you down the hall to the cardiologist, and they could send you for an MRI and to get some blood drawn so they can run some labs," says Eiss at Banner. "That could all happen in the same building and then you pick up your prescription from the pharmacy on your way out."

This type of facility is particularly applicable in remote communities, which cannot sustain a full-service hospital. "You would go there for things like dialysis, or nutrition information if you're diabetic, or if you need help," explains Kevin Cassidy, global healthcare lead at WSP, based in Canada, who is involved with several projects like this in Nova Scotia. These facilities will be combined with long-term care homes and coffee shops and, in one case, a school. "So it's more of a hub for wellness that's embedded in the community, a destination for people to stop. It helps you stay healthy so you don't need to drive to a distant major city so often. If we're looking at how to reduce the cost to the system, you need to have a healthy lifestyle to begin with and that's supported by these community health centres."

Healthcare begins in the community

The bigger picture is that we need to stop equating health with hospitals, believes Lord Nigel Crisp, a former chief executive of the UK's NHS. "We get trapped into thinking in very traditional ways and we always start with the acute. This should be the opportunity for us to think the other way around, so you don't start by saying 'what do we need to do for cardiac patients or cancer patients', it's 'what do the people in this community need'. Only when you can't provide that in the community should you end up taking someone to a facility."

Community services are less visible and therefore lower priority, he says — "it's easier to cut two district nurses than it is to close a ward" — but they play a massive role in freeing up capacity in acute hospitals. In 2015, Crisp led

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LORD NIGEL CRISP,
FORMER CHIEF EXECUTIVE, NHS

a review of mental health admissions in NHS psychiatric wards. "We found that on average 40% of people probably shouldn't have been there, and it was because there weren't community facilities for them to go to."

He has just published a book, *Health is made at home, hospitals are for repairs*, which argues for a much wider conception of health and distinguishes between preventative healthcare and broader health-creating activities in society. (We'll consider the social determinants of health and the role that cities play later in this series.)

Nurses are the future

In a future of more virtual, more community-based care, there will have to be changes in the healthcare workforce too. Today, only half of all countries have enough healthcare workers to deliver quality services, and no country is on track to meet the World Health Organization's health-related Sustainable Development Goals by 2030. There is a demographic problem too: over the course of the next three decades, the number of people of working age for each person over 70 will plummet from 10.4 to 5.4.

Crisp is also co-chair of the global campaign Nursing Now, and he believes nurses will play a much greater role. "We will always want highly trained specialist staff, but most need for healthcare is now in long-term conditions and most of those can be better managed in the community, where you can anticipate acute episodes and head off people going into hospital. I suspect that we will start to see that nurses can do 80% of what doctors do in primary care, especially

with virtual consultations and new technology."

In Africa, where Crisp has been working for the last 15 years, nurses are already the lynchpin of clinics in both rural and urban areas. In rural Kenya, midwives scan pregnant women using portable ultrasound machines and the readings are sent to a regional centre in Nairobi. "They get an instant report back so that they are able to talk to the mother about how her baby is developing and whether or not she needs to come into the hospital. There's no reason at all why this sort of model shouldn't develop in places like the UK. There's a lot we can learn from low-income countries because they're making massive changes without resources, and necessity is the mother of invention."

The bottom line is perhaps that healthcare systems around the world are stuck in a 20th century industrial model while other sectors have transitioned. "We still have a production line sort of approach and language and methodology, whereas society generally has moved to a knowledge-based economy," says Crisp. "A post-industrial model will be much more individual, with a holistic approach that is horizontal rather than linear." ●

The expansion of virtual and community services as a result of COVID-19 is a positive thing — but we can't let fear be the driver. Healthcare systems cannot be successful if people are too scared to seek the care they need. In the next part of the series, we'll look at the lessons for infection control in healthcare environments: what we need to do differently to make them safe, both in reality and perception.

Continue the conversation

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AFTER COVID-19, HOW CAN WE MAKE HOSPITALS SAFE?

The pandemic poses new challenges and some very big questions

As the COVID-19 pandemic has swept the world, it has threatened to overwhelm healthcare facilities with a surge of critically ill patients. But there is another, more profound impact: it has changed the relationship between patients and caregivers, and raised questions about hospitals' safety both as places to seek help and places to work.

Infection prevention and control has always been a key priority in modern healthcare, but it was focused primarily on protecting patients from diseases in the hospital environment and controlling drug-resistant "superbugs". With COVID-19, everyone is a potential victim and everyone — no matter how healthy they may appear — a potential carrier. We cannot afford to close hospitals and it is not sustainable to run them at lower capacity for extended periods of time. Instead, we have to find ways to keep them functioning safely and efficiently while there is a higher level of infectious disease circulating among the population — in the certainty that COVID-19 will not be the last pandemic we face, and that the next one may not be transmitted in the same way. This will involve rethinking everything from how hospital workers are protected, to the way that hospital environments are engineered.

"On one level, you could argue that the hospital is no different to any other part of the environment in which we are trying to understand how to protect people from each other. But it's particularly important because you've got a concentration of the sickest people, and you have healthcare workers exposed to levels of COVID that most of us wouldn't see outside of our own household," says Professor John Clarkson, director of the Engineering Design Centre at the University of Cambridge, a member of its infectious diseases research centre and an expert advisor to the UK's government's COVID-19 winter planning report. "Because of what we know about COVID, we have to revisit everything we do in a hospital, and every interaction we have. It changes the whole way you look at the world."

PPE: the last line of defence

In the immediate response to COVID-19, there has been much activity and concern around the world about securing adequate amounts of personal protective equipment (PPE) to protect frontline healthcare workers. Since the start of the pandemic, Clarkson has been working with surgical teams at Addenbrookes teaching hospital in Cambridge to understand their experiences of wearing face masks, and ultimately to develop better models: "You want the right mask for the right person at the right time for the right

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PROFESSOR JOHN CLARKSON, UNIVERSITY OF CAMBRIDGE

procedure, and that could be very wide-ranging." Most PPE is not designed for healthcare, and not for protection from viruses. Clarkson's project involves detailed feedback with medical teams but also using imaging equipment to capture face shapes. "Are they all utterly unique, or can they be clustered in some way so that you could have a wider set of standard masks that would fit more people, more like shoe sizes? Where that's not possible, can we print an element of the mask that sits around the face that is uniquely shaped for the individual, to accommodate the movement they need?"

Clarkson takes a "systems thinking" approach to healthcare improvement, which seeks to gain a deep understanding of the context of a problem before trying to solve it. Through this lens, the protection problem becomes a proxy for much wider challenges, he says, intrinsically linked to the physical environment, its layout and ventilation, and how people move through it. "It's not just about the mask, it's about everything else in and around the use of it that defines whether you have a good mask or not. The patient, the porter, the nurse, the physician, the surgeon, they all have a different pathway through the hospital — the things they touch, they people they get close to. Only with that holistic understanding of exactly

how people and things move around can you really start to put in place a safe environment for patients and providers."

Occupational hygiene — the discipline of managing hazards at work — also views PPE as the last line of defence in a much wider system. Peter Aspinall, principal occupational hygienist with WSP in Brisbane, is a former nurse himself, though these days his work focuses mainly on industrial workplaces. "We talk about a hierarchy of controls," he explains. "We start by trying to eliminate the hazard, then we look at mitigation through engineering design. If you walk into a mine today, it's totally different compared to 50 years ago. That's what's going to have to happen in hospitals. We need better designed workflows through hospitals and better ventilation, so that these areas can be as safe as possible. The piecemeal fixes that we've used for COVID like outdoor screening clinics are not sustainable."

Pandemic operations — without the tents
Starting from the top of the occupational hygiene hierarchy, an important way to reduce the risk is to manage the flow of potentially infected people through a hospital building or campus. Bracing themselves for a surge in COVID patients, healthcare systems had to respond quickly with temporary fixes, such as triage tents in parking areas. For the longer term, a pandemic operations plan will be essential for both existing and new facilities. "Our clients are starting to look at how they can get a patient who presents at an emergency department to an exam room and to a patient bed with the lowest amount of risk," says Kevin Chow, senior associate and healthcare specialist at WSP, based in Dallas. He is involved in the design of a hospital tower on a healthcare campus in Fort Worth, Texas, where the emergency department (ED) is in a separate building. "If the ED sees a surge, this tower might become a place to put infectious patients. The tower has a pre-admit testing space on the first floor, so we're looking at having a separate entrance and parking area, to bring in infected patients in a single flow, get their vital signs and take them up to a dedicated floor. Normally we would assume that everyone would go to the ED, but we are looking at different options for this level of surge that don't involve tenting."

What about the working environment itself? Hospitals are already designed and operated to reduce infection from contaminated surfaces. Cleaning is frequent, nooks and crevices are designed out, and surfaces are wipeable, with antimicrobial materials and coatings. There

may be opportunities to install additional touch-free controls in bathrooms and on doors, and to increase the number of hand hygiene stations and sanitizer points. Robot cleaners can reduce the risks for human teams by disinfecting rooms with UV light before they go in.

The vital role of airflow
Aside from people, airflow is the other key transmission route for disease. Ventilation and air-conditioning plays a vitally important role in controlling the spread of infection in a hospital, not only by purging spaces of airborne pathogens, but by creating negative or positive pressure relationships that either prevent air from escaping or entering a space. Isolation rooms for infected patients are negatively pressurized so that nothing can escape; operating theatres and protective spaces for the immunocompromised are positive so that nothing can enter.

Research is ongoing into the routes by which the SARS-CoV-2 virus that causes COVID-19 is transmitted. The World Health Organization's latest guidance, published in July 2020, says that it spreads from person to person through infected secretions such as saliva, or via respiratory droplets that are expelled when an infected person coughs, sneezes, speaks or sings. These may be →

WE NEED BETTER DESIGNED WORKFLOWS THROUGH HOSPITALS AND BETTER VENTILATION, SO THAT THESE AREAS CAN BE AS SAFE AS POSSIBLE

PETER ASPINALL, WSP

ingested by a person in close contact (within 1m), or they may fall onto nearby surfaces, where the virus can survive for a period of time from a few hours to several days. Airborne transmission of SARS-CoV-2 can also take place during medical procedures that generate aerosols — smaller particles that may remain suspended in the air over longer distances and time periods. Scientists continue to debate and investigate whether airborne transmission may occur in the absence of these procedures, particularly in indoor settings with poor ventilation.

The coronavirus that caused the SARS epidemic in 2002-04 was fully airborne, and this proved a transformative experience for hospital design in Asia. COVID-19 is likely to do the same for the rest of the world. "In Singapore, hospital design has evolved in quite a significant way since the SARS outbreak," says WSP principal Lionel Neo, a specialist in engineering healthcare buildings. In the aftermath of that epidemic, Singapore's government hospitals adopted a range of measures to improve indoor air quality, including purging systems, higher air-change rates, higher levels of filtration, and UV light and titanium coatings on cooling coils in air-handling units to kill bacteria and viruses, says Neo. "When COVID-19 hit, the systems were already in place, and hospitals were mostly considered pretty well-equipped to tackle it."

These measures are not in place all the time — in Singapore's tropical, humid climate, the cost and energy required to constantly refresh all the air would be enormous. Instead, systems have dual ventilation modes, so that in the case of a pandemic — or a severe air pollution event, as caused by forest fires in neighbouring Indonesia in 2019 — they can be switched to fully exhausted, isolation, or mechanical ventilation and spot cooling mode.

To achieve this, air handling is strictly zoned in new hospital designs. "That starts from floor-by-floor planning, then zone-by-zone, and then department-by-department," says Neo. "An air-handling unit is not shared by more than one department, so that the air-handling operation can be contained within that department itself." Ventilation systems are designed to mirror the workflow of each department — so in a sterile services unit where contaminated equipment is returned and cleaned, air flows from sterile to clean to dirty areas before being exhausted out.

Singapore's hospitals are already fitted with prefilters with a MERV rating of at least 7, and a secondary filter of at least 14, but there are also empty slots so that HEPA filters (MERV 17

OUR CLIENTS ARE STARTING TO LOOK AT HOW THEY CAN GET A PATIENT WHO PRESENTS AT AN EMERGENCY DEPARTMENT TO AN EXAM ROOM AND TO A PATIENT BED WITH THE LOWEST AMOUNT OF RISK

KEVIN CHOW, WSP

or higher) can be added during a pandemic or air pollution event, and fans are sized to handle the additional resistance that this creates. "In terms of the whole hospital project, the cost is marginal — a fraction of the total project cost," says Neo. Increasing floor-to-floor heights has a greater knock-on effect: in more recent designs, a standard 4.3m has been raised to 5m or ideally 6m. "The extra air changes, purging and dilution that's required pushes up the need for ceiling space, so floor-to-floor heights inevitably have to increase as well to give us a bit of headroom, especially in light of COVID. Provision for extra and well-placed mechanical ventilation risers should also be considered during the planning. When it comes to fitting out existing buildings with smaller heights, it can be quite a challenge."

Increasing isolation capacity

Another feature of Asian hospitals is a much greater number of isolation rooms for patients with airborne diseases, to prevent infection spreading to the rest of the hospital. These are essential for aerosol-generating procedures such as intubating critically ill patients before placing them on a ventilator. Elsewhere in the world, there are typically very few, and they are often scattered throughout different acuities. "Isolation rooms became extremely important during COVID, but we just didn't have enough

IN SINGAPORE, HOSPITAL DESIGN HAS EVOLVED IN QUITE A SIGNIFICANT WAY SINCE THE SARS OUTBREAK. WHEN COVID-19 HIT, THE SYSTEMS WERE ALREADY IN PLACE, AND HOSPITALS WERE MOSTLY CONSIDERED PRETTY WELL-EQUIPPED TO TACKLE IT

LIONEL NEO, WSP

because we hardly ever needed to use them — a typical 100-bed hospital might have four," says Gary Hamilton, an HVAC specialist and healthcare practice leader at WSP, based in Washington DC.

True isolation rooms are completely sealed and gasketed, with hard, wipeable ceilings, and equipped with HEPA filtration, two fans in case of failure and emergency power, as well as a pressure display and alarm so that staff know it's safe to enter. During COVID, hospitals were forced to improvise negative pressure in normal rooms by installing fans extracting to the outside, and disconnecting return vents or installing higher-quality HEPA filtration to prevent the infection spreading through the hospital ductwork. "There's an extreme amount of risk associated with using regular patient rooms without any treatment or diversion of the air going back to an air-handling unit," explains Chow. "If the duct systems are interconnected with spaces not utilized for pandemic operations, you could be spreading contaminants from a COVID area to other parts of the hospital."

Healthcare systems are now reviewing options for increasing isolation capacity. One option is to install entire floors of these rooms in major hospitals, so that staff can be properly trained in how to use them before an event occurs, and then infectious patients would be centralized in that location. Another is to design normal patient rooms so that they can be switched to negative pressure and fully exhausted in the event of a pandemic. This is common practice in Asia — at Kwong Wah Hospital in Hong Kong, WSP engineered a 176-bed isolation facility, and 162 further beds that are convertible to isolation mode if needed, out of a total of 1,140.

But rooms with switchable pressure relationships are not necessarily permitted under current building codes elsewhere, for example in some US states. The objection is not the switch to pandemic mode; it is what happens when you switch them back. With an airborne infection isolation (AII) room, all of the air is always fully exhausted all of the time, so it just needs to be disinfected between patients. A switchable room will be fully exhausted during a pandemic event, but the air will have to travel through a section of ductwork before it reaches the exhaust fan. When normal operations resume and air is again returned through that ductwork, there is a risk that some pathogens will remain. "When HVAC systems are utilized in areas with infectious disease patients, there is a risk that contaminants have settled in the duct," says Chow. "To mitigate the risk, you would want to make sure that you've

cleaned that ductwork all the way through." But cleaning ductwork isn't a regular part of hospital maintenance: "There are ways to do it, but it's not something that a typical healthcare facility has ever had to deal with. Code requires that hospitals use filtration to make sure that air going down the supply ductwork is clean, but the particles from this virus are not large enough to be caught by the normal filtration required for patient rooms."

There remains the question of whether HEPA — high-efficiency particulate air — filtration is sufficient, or whether it is necessary to go to the next level: ultra-low particulate air (ULPA) filtration, which catches 99.999% of particles as small as 0.1 μm.

During COVID, many hospitals have also installed HEPA filtration on exhaust systems to properly treat air from isolation rooms before it is ejected from the building. "There is a concern that contaminated air is discharged where it could be breathed in, or entrained in the outside air of an air-handling system serving an adjacent building," explains Chow. Going further, high-velocity plume fans are installed for laboratories or pharmacies preparing chemotherapy drugs: "Fan discharge velocity is used to create a plume high enough for dilution to mitigate a potential threat. High-velocity plume fans in conjunction with high-efficiency filtration would be considered for a true airborne pandemic."

Whether COVID-19 is proven to be fully airborne or not, it should serve as a warning, says Hamilton, and a spur to more forward-thinking, resilient planning. "For the future, all hospital systems will absolutely have to be designed to meet these extra requirements. We need to create a

ISOLATION ROOMS BECAME EXTREMELY IMPORTANT DURING COVID, BUT WE JUST DIDN'T HAVE ENOUGH BECAUSE WE HARDLY EVER NEEDED TO USE THEM — A TYPICAL 100-BED HOSPITAL MIGHT HAVE FOUR

GARY HAMILTON, WSP

healthcare system that can help us to cope with any kind of future pandemic — we can't afford the risk of having a system that is unable to handle something like this." ●

Of course, hospitals must not only be safe — they must also be perceived to be safe or they cannot perform their essential role. There is worrying evidence that people who have needed medical assistance during COVID-19 have been too frightened to do so for fear of catching the virus. So can we reassure them? We'll consider this in the next part of the series.

Continue the conversation

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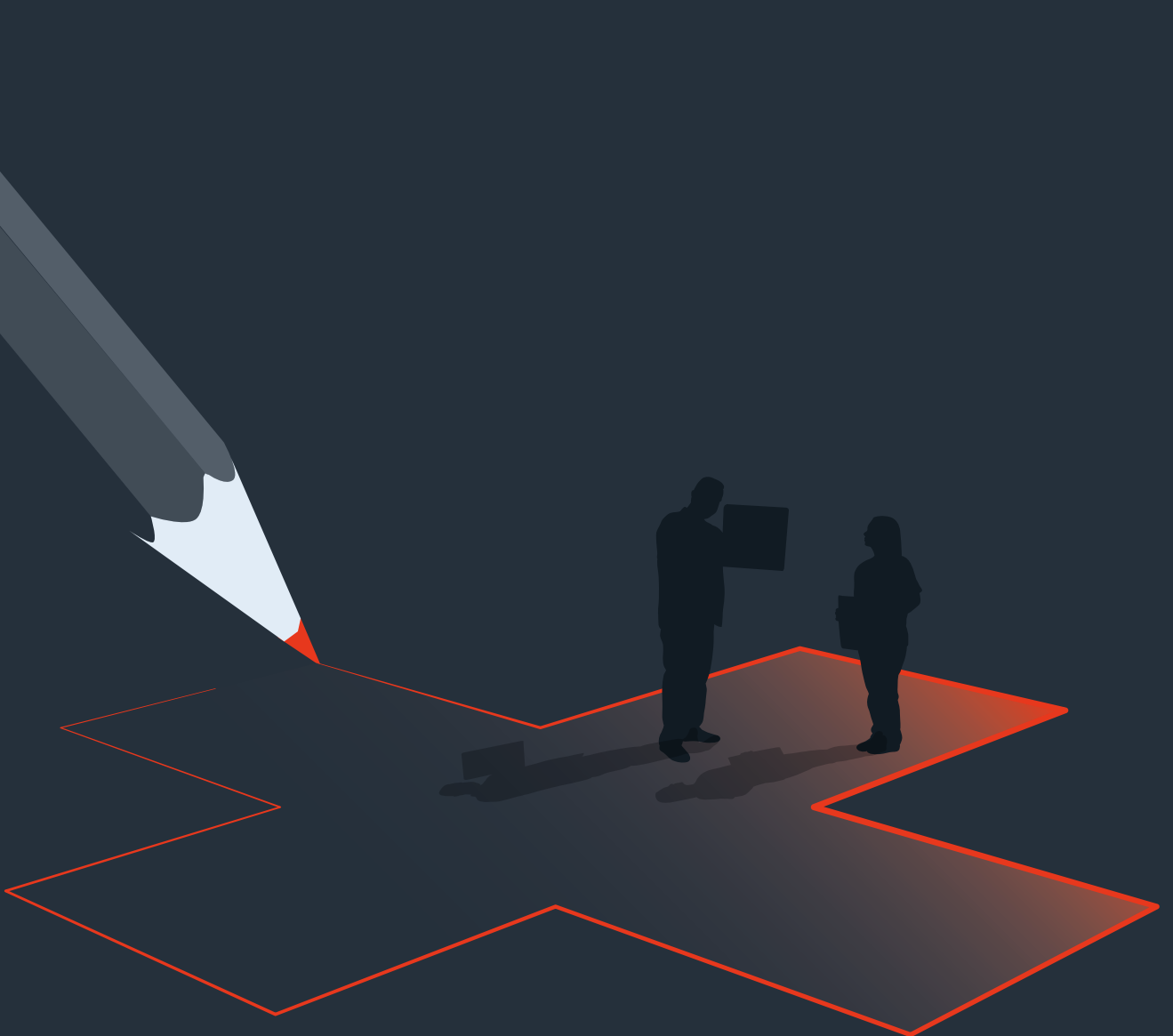
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CAN HOSPITAL DESIGN INSTIL TRUST?

Healthcare facilities must not only be safe, but be perceived as safe

Healthcare workers are the heroes of the pandemic; hospitals the epicentre. These buildings, always freighted with emotion, have become even more symbolically charged at this time of societal trauma and crisis. As telemedicine replaced in-person consultations and elective procedures were cancelled, going to the hospital in most cases became the preserve of the sickest — an often terrifying journey, with loved ones left behind and forbidden from visiting.

These measures were essential to free up bed capacity and to prevent COVID-19 from spreading, but the unfortunate side-effect has created the impression that hospitals are not safe places to be — an impression we urgently need to dispel, both for the health of the population and the sustainability of the institutions themselves. There is growing anecdotal evidence that people in need of urgent medical care are choosing not to go to hospitals, prompting concern that "COVID-phobia" could lead to a second wave of deaths indirectly caused by the virus. A study published in the Journal of the American College of Cardiology in June showed that the number of severe heart attacks being treated in US hospitals had fallen by nearly 40% since March. Doctors in other specialities treating conditions such as strokes have described a similar decline. Meanwhile, a poll by Incisive Health of 2,000 adults across Europe, in France, Germany, Italy, Spain and the UK found fear of COVID-19 impacting on willingness to engage with the healthcare system, with 49% scared to go to an emergency department and 42% scared to consult a hospital-based specialist.

Awareness of infection risks has certainly increased across the population, a change that is likely to be long-lasting, if not permanent. Every building owner will need to respond to this, but

for healthcare providers, the stakes are higher than most.

"There is a public perception that hospitals are dirty and germ-infested," says Steve Eiss, executive director of facilities development at Banner Health in Arizona. "Every time during this pandemic I mentioned that I was going to the hospital people thought I was crazy and I had to explain that I felt safer there than I do at the grocery store. Those of us who understand hospitals know that they are already designed to be inherently cleaner and safer than most buildings, and to filter and circulate air better."

So how can we communicate that to the wider population?

Managing uncertainty
Colum Lowe, now director of the Design Age Institute at the Royal College of Art in London, has faced this challenge before. He was head of design and human factors for the NHS's National Patient Safety Agency from 2003 to 2007, when hospital-acquired infections and MRSA became a cause celebre for the press and an election campaign issue. "Every day there seemed to be another headline about the NHS 'superbug', and people were worried about going into hospital because they thought they were going to get an infection," he remembers. In the case of COVID-19, this anxiety is compounded by uncertainty: "The science is not absolute at this minute, and as evidence grows, we're frequently getting what appear to be conflicting stories even from reputable news channels. Add social media to that, and nobody knows what to look to."

Clear messaging is vital to maintaining public confidence. Some of this is outside of healthcare providers' control, but they do have control over the messages that patients receive when they seek care and during their visit to the hospital. Then as now, one of the main strategies was a handwashing campaign, which both reduced infection rates but also provided reassurance to patients. Details matter, says Lowe, because in the absence of clear messaging, we are hyper-sensitive to information from our environment. "The world is a complex place, so as humans we pick up cues of quality from everything around us. In the FMCG [fast-moving consumer goods] sector we call it 'brand', but of course the same is true in healthcare environments." While he was at the NHS, he drew on research from the aviation sector showing that if the seat on an aeroplane toilet was broken, passengers were more likely to think the plane would crash: "If you cannot look after a toilet seat, what chance of a

DETAILS MATTER BECAUSE, IN THE ABSENCE OF CLEAR MESSAGING, WE ARE HYPER-SENSITIVE TO INFORMATION FROM OUR ENVIRONMENT

COLUM LOWE, ROYAL COLLEGE OF ART

Rolls-Royce jet engine? If you walk into an A&E department and you see litter on the floor, a bed in the corridor, people getting angry because they've been waiting too long, everything looking just a little bit out of control, your perception is that the whole place is in crisis."

Every detail counts

So hospitals need to look conspicuously safe, in every respect. "To reassure the public, we need to show a strength of response," says Suzanne MacCormick, a clinical planner and previously global healthcare lead at WSP. "We need to be talking about how we manage infection prevention and control as part of our business-as-usual, and how we are managing the differences in this virus. People need to see visual cues that we are doing everything we can. We've put in extra layers of cleaning but we need to make that very visible. Equally, there needs to be exemplar behaviour from the staff to encourage compliance from the public."

Every premises has had to install notices informing people of the measures that have been taken to protect them, and how to comply. But this isn't enough. The problem with signage, says MacCormick, whether reassuring or instructional, is that we cease to notice it after we've seen it a few times — it becomes part of the landscape. This is also why it is so hard to change ingrained habits. The subconscious mind is much more powerful than the conscious mind and constantly searching for clues to make sure we're safe, but it also determines our behaviour — most of the time, we're on autopilot. She has visited hospitals where the corridors have been decked with one-way and no-entry signs: "So you are always supposed to walk on the left-hand side. But when you watch the staff, they take no notice of the signs because they no longer see them."

MacCormick has a clinical practice focusing on the neuroplasticity of the brain and works with patients who have a psychological component to their illness. "Once learned, all behaviour is done subconsciously," she explains. "You're going to walk the same route because you've always walked it, even if there's a sign saying otherwise. So we need to bring people back to the conscious state, make them aware of what they're doing and nurture them to do it more effectively." One technique is "pattern interrupt", changing something in the environment to jolt the brain and disrupt automatic behaviour. Opening doors, for example, is something we learn at an early age and then continue to do subconsciously. "We know that you push a handle down, twist a

THOSE OF US WHO UNDERSTAND HOSPITALS KNOW THAT THEY ARE ALREADY DESIGNED TO BE INHERENTLY CLEANER AND SAFER THAN MOST BUILDINGS, AND TO FILTER AND CIRCULATE AIR BETTER

STEVE EISS, BANNER HEALTH

knob, pull a looped handle and push a flat plate," says MacCormick. "If we try to pull a looped handle only to discover it requires pushing, we're snapped into reality. This interrupts our learned behavioural pattern and demands conscious thought, so we can use this technique to challenge and change behaviour."

Interventions that can't be ignored

Design interventions can act both as pattern interrupters to encourage better habits and to engender trust. A relatively simple step is to install more hand hygiene stations for visitor use throughout hospitals, including at the entrance. "When you walk into a healthcare facility, there's a sink with soap and paper towels or some other way to dry your hands, and signage telling you to wash your hands," says Kevin Chow, senior associate and healthcare specialist with WSP in Dallas. "Instead of just trying to change behaviour when it's a health crisis, we need to make sure people are washing their hands all the time." We also need to design out shortcuts, says Tomer Zarhi, mechanical manager in WSP's Canadian healthcare team. "Don't put a hand sanitizer dispenser right next to a handwashing basin, because people will use that instead of washing their hands properly."

Another powerful visual cue at the entrance of a hospital would be a display showing the air quality inside. Air-handling systems are not traditionally a mainstream preoccupation, but COVID has thrust them into the limelight. One of Zarhi's friends is a dentist: "Patients are calling

him and asking 'what is your air change rate, what level is your filtration'." Hospitals could use this extra scrutiny to help tackle the perception problem, by displaying air quality monitors to patients as they walk in, he suggests. "There are inexpensive technologies that can monitor the air quality in rooms and in larger spaces such as an atrium. It adds transparency — we need lights and whistles to show patients it's safe to be inside." This could become a point of competition for hospital owners and managers, in the same way that publicly displaying energy consumption has influenced the market for greener buildings. "Hospitals can already say they're doing well on in-house infection rates, but that's just a number. If you see a monitor walking into a hospital, that's a big deal." This would also help to underline hospitals' higher performance in comparison to other types of buildings such as offices or restaurants.

Providers can also use digital technology to supplement environmental cues and make the hospital experience more transparent, says Nolan Rome, director of WSP's US healthcare practice. "The long-term plan was that access to healthcare would start from your couch, from your iPad," he says. "Preparing for your visit reduces your anxiety and gives you more control over your environment and your experience." This has been accelerated during COVID-19, as providers turned to smartphone apps to help manage the flow of people into a facility. Patients wait for their appointment in a virtual queue at home, and the app lets them know when to leave and provides directions to help them navigate through the hospital. "Healthcare systems have been talking about the concept of 'concierge healthcare' for a while, as a way to enhance the experience, so that you weren't inconvenienced or wasting your day. Before COVID, that was just a really whizbang thing to do, but now it's a requirement because you can't just show up and congregate in a lobby like you used to."

For those who are still very anxious about going to hospital, video consultations could potentially

WE NEED TO DESIGN OUT SHORTCUTS. DON'T PUT A HAND SANITIZER DISPENSER RIGHT NEXT TO A HANDWASHING BASIN, BECAUSE PEOPLE WILL USE THAT INSTEAD OF WASHING THEIR HANDS PROPERLY

TOMER ZARHI, WSP

be a lifesaver. "The healthcare industry has been slow adopters of some technologies, but for most things, a video consultation does work," says Lowe. With his Design Age Institute hat on, he thinks more needs to be done to give older people alternative means of seeking help. He recently spent three months seconded to NHSx, the UK health service's digital agency, installing tablet computers in care homes. "It's a myth that older people can't use technology — 77% of them are online, and by the end of this pandemic, it will be even higher. They want different ways of accessing healthcare, so we need to find innovative ways to reassure them and allow them to stay well." ●

Broadening the options so that it's not always necessary to go to hospital will also make systems more resilient in the event of future pandemics or other crises. But resilience in healthcare stretches far beyond the walls of any single facility — a system is only as resilient as its weakest link, and it may not always be apparent exactly what that is. We'll consider what true resilience looks like in a post-pandemic age next in the series.

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SO, WHAT DOES A RESILIENT HEALTHCARE SYSTEM LOOK LIKE?

Examining why we weren't ready can help us equip for future disasters of any kind
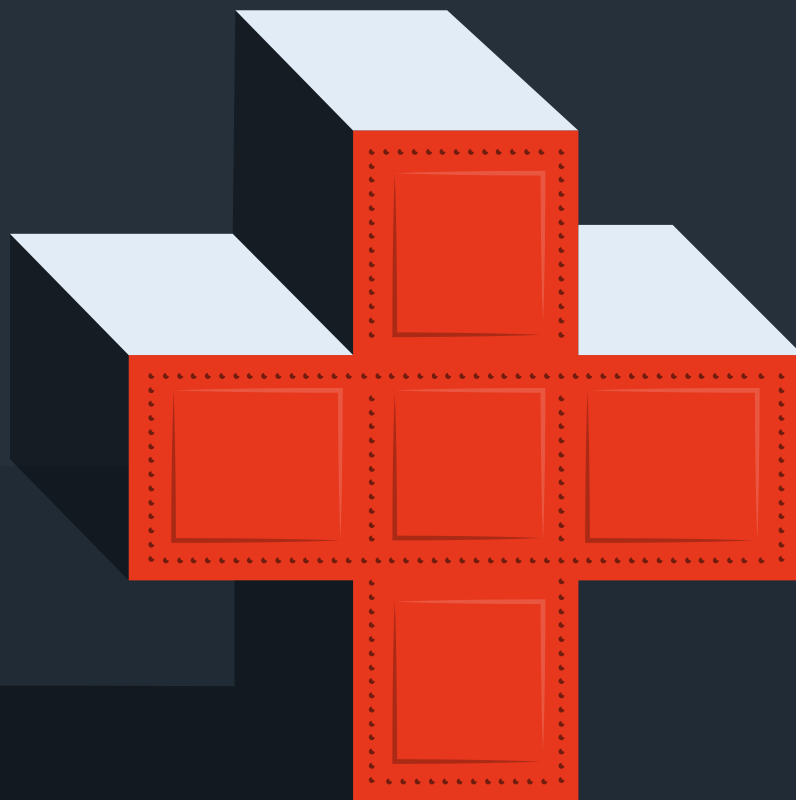
We thought we were planning for resilience. But we weren't prepared for this.

COVID-19 is an unprecedented global crisis, but epidemics have been increasing in both frequency and reach due to globalization, greater connectivity and denser cities. The pace at which healthcare systems were able to respond, and the scale of the transformation, are an incredible achievement. But they also serve to highlight how ill-equipped the world was for a pandemic of this kind. COVID-19 has shone a spotlight on systems and processes that had been fine-tuned over many decades, revealing flaws and vulnerabilities that we had overlooked, as well as glaring blind spots in our forecasting.

Most fundamentally, COVID has reinforced the fact that healthcare is a system, and that it will only ever be as resilient as each of its components, however minor a role they may seem to play. Flexibility and agility are essential components of resilience, but these are often value-engineered out of systems optimized for efficiency and minimum cost. If we are to be better prepared in the future, we may need to reconsider our notions of "value" and the potential consequences of leaving so little room for manoeuvre.

"This has shown that resilience isn't just about being belted and braced for the things you think may happen," says Suzanne MacCormick, a clinical planner and previously global healthcare lead at WSP. "It's about being prepared for the things you really don't have any visibility on at all."

Resilience only exists at a system level
But perhaps that's the problem: resilience planning has typically taken place at the level of a single location, healthcare system or hospital, while a pandemic, by definition, has no respect for boundaries.

"Systems tend to operate in relative isolation and they're designed for disaster in their own bubble," says Kevin Cassidy, global healthcare lead at WSP, based in Canada. "If there had been an outbreak of COVID in one hospital, they would have been well prepared, especially the newer ones. But this particular virus hit everybody at the same time — not just within a local community or a province or even a country, but the world." In Canadian building code, hospitals have to be "post-disaster" facilities, says Cassidy. "But when you dig into it, what that really means is that they need to be able to stand up after earthquakes or hurricanes because they are supposed to be areas of refuge." This is of little value if all the roads that lead to a hospital are not designed to

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SUZANNE MACCORMICK,
CLINICAL PLANNER

withstand the same level of impact, he points out — a system is only as resilient as its weakest link.

The pandemic presents a more fundamental challenge to this conventional approach to crises, points out Michael Pietrzkiewicz, an electronics engineering technologist at WSP in Alberta, Canada: "A lot of disaster planning is based on having a shelter to protect people from the elements, where we can provide services in one place. But with COVID, we found that we couldn't mass people together because that's the way the virus spreads."

Long-term care: the weakest link

This failure to think holistically — or to plan for a different kind of disaster — has been felt most tragically in the disconnect between health and social care systems. In many countries, a high proportion of COVID deaths have been in care homes for older people, or among those receiving care at home. This is partly because older people are more vulnerable to the disease, but also because of the way that care is funded and, crucially, staffed. Care work is typically low status, poorly paid and insecure, leading to a high-turnover, highly mobile workforce, who often visit multiple locations in a single day — the perfect conditions for a virus with a long incubation period.

"Hospitals are often the focus, but there are many other supporting areas of healthcare," says Sarah Wallwork, principal consultant in WSP's UK healthcare advisory team. "Care homes hold considerably more places than hospitals, so if they were better protected, this could stop or slow down hospital admissions and deaths related to COVID or a future pandemic. We need resilience in all of these supporting areas — primary care, mental health, social care, community services — to give us resilience across the whole system."

Wallwork says that the UK's healthcare resources were already stretched before COVID, with occupancy of hospital beds usually close to 100%. This is partly because of a significant shortfall in social care funding, which means frail older people are stranded in hospital because there is no care home place available, or no support to help them in their home. Social care is run separately from healthcare, the responsibility of local authorities, though the National Health Service has recently begun to introduce "integrated care systems" to bring together the different service providers in a local area. Joining up the system would improve resilience in various ways, she says — for example, organizations in the care sector might have

been better able to access personal protective equipment (PPE) via their healthcare partners: "Acute hospitals already have defined supply chains or may have been able to tap into a central procurement process, but care homes, hospices and carers who go into people's homes were unable to do this and struggled to procure any." This strategy was broadly similar among both public systems like the NHS and private healthcare services, based on a survey of WSP's global client base.

Supply chains geared to lowest cost, not resilience

Procurement is one of the areas that has been found most wanting. Global supply chains have been ruthlessly optimized for efficiency, leaving them with little capacity to accommodate sudden fluctuations in demand — as consumers trying to stock up on toilet roll found to their dismay.

Over the last 30 years of globalization and outsourcing, the world's manufacturing base has shifted overwhelmingly to Asian countries, particularly China, which makes more than 50% of the world's PPE. Hubei province, where the virus struck first, is one of the country's →

SYSTEMS TEND TO OPERATE IN RELATIVE ISOLATION AND THEY'RE DESIGNED FOR DISASTER IN THEIR OWN BUBBLE. IF THERE HAD BEEN AN OUTBREAK OF COVID IN ONE HOSPITAL, THEY WOULD HAVE BEEN WELL PREPARED, ESPECIALLY THE NEWER ONES

KEVIN CASSIDY, WSP

→ most important manufacturing centres. As governments realized the scale of PPE that would be required, international cooperation broke down. Exporters froze shipments, and buyers found themselves in a desperate scramble for masks, gowns, gloves and goggles, competing with international neighbours and with providers in their own market. In March, the World Health Organization called for a 40% increase in PPE production, and warned that supply chain disruption — "caused by rising demand, panic buying, hoarding and misuse" — was putting the lives of frontline medical workers at risk.

"The global supply chain just stopped because everyone wanted the same product at the same time, even though they didn't need it at the same time," says Mathias Elmfeldt, a hospital logistics expert with WSP in Sweden. "That created a lack of trust in the system, and that was right — you can't trust an imperfect system." Cooperation failed because the system wasn't primed for it in advance — once a crisis has hit, it's too late. This lies partly in the realm of global politics, but a practical stumbling block is that healthcare does not use a common language to describe medical equipment, says Elmfeldt. "You can't cooperate unless you have full transparency of your supplies. The same tube will have different names, so even though there are a lot of electronic systems, it is impossible to aggregate information on stock levels." A common language has been developed by GS1, the not-for-profit inventor of the barcode, which covers not only equipment but every kind of information about hospitals, caregivers and patients, and Elmfeldt thinks this could improve efficiency and resilience in many areas. But while the fiercely competitive grocery sector has been using an equivalent for 50 years, healthcare has been slow to implement it.

There are already initiatives to increase regional manufacturing to counter the over-reliance on Chinese healthcare suppliers. Elmfeldt says that taking advantage of advances in digitalization, automation and 3D printing could make local suppliers more competitive, but that procurement needs to look beyond lowest cost and factor in proximity, lead times and geographic diversity too. Materials requirements planning (MRP) systems could also make better use of artificial, or human, intelligence to forecast the impact of a range of different scenarios, rather than treating the future as a steady continuation of the recent past.

"If you can categorize articles and understand potential demand, then those very important items can be stockpiled and held in reserve,

WE NEED RESILIENCE IN ALL OF THESE SUPPORTING AREAS — PRIMARY CARE, MENTAL HEALTH, SOCIAL CARE, COMMUNITY SERVICES — TO GIVE US RESILIENCE ACROSS THE WHOLE SYSTEM

SARAH WALLWORK, WSP

and you can have greater requirements for multiple sourcing and regional manufacturing," he says. "Before, we just procured from the cheapest company and then everything happened to be manufactured in Asia. Now we might have a requirement to have a supply in Europe or within five hours." Products coming from Asia via container ship can take two months to arrive, he points out — an unacceptable delay for essential items.

Gearing up local manufacturing industries would also tap into the greatest source of resilience in the system: people. "What I learned is that the people themselves created a lot of the agility, in terms of the fast-moving reaction to COVID, and they were very, very good at doing that," says Elmfeldt. "That will be the case the next time too."

The value of agility
Agility has not been sufficiently prized in the past, says Kealy Herman, a specialist in supply chain sustainability with WSP in Denver. "Organizations have been so focused on efficiency that they don't see the value of flexibility — especially because flexibility often costs money and the return on investment isn't clear, at least in the immediate term," she says. "Now it's becoming very clear that the companies that are more flexible and agile are better able to respond to these types of threats, and there's a window of opportunity to address some of these issues."

When they carry out tabletop exercises for clients, Herman and her colleague Emily Wasley find that organizations are frequently unaware just how exposed they are to a single source, not necessarily among their direct suppliers but in the hidden tiers below. "The companies that are faring well right now are the ones that have conducted a supply chain assessment looking at who their critical suppliers are and where they are, and have that relationship with their suppliers — which is huge in itself," says Wasley, leader of WSP's corporate climate risk and resilience practice in San Francisco.

This is borne out by the example of Bon Secours Mercy Health, a healthcare system with 35 acute care locations across the eastern US, from major urban hospitals to much smaller critical access facilities in rural areas. There were capacity issues in some locations, says infrastructure director Jonathan Hunley, but it hasn't struggled for supplies because of a corporate supply chain initiative that was already underway. "From a supply side, we were actually in very good shape because we had been working to establish warehouses in our markets to create overstock and then use just-in-time deliveries for those supplies," he explains. "That will create more space inside of our hospitals for clinical functions and it's whole lot easier to control than storing equipment inside the hospital."

We can't afford to neglect maintenance
Building system maintenance is another Cinderella topic that suddenly everyone wants to talk about, and an area where previous economies may have hindered resilience. "When COVID hit, hospitals that hadn't been performing preventative maintenance suddenly started looking at their filters or HVAC systems and realized they weren't good enough," says Tomer Zarhi, mechanical manager in WSP's Canadian healthcare team. "The focus is now back on things that have been neglected for many years." Cleaning air ducts every ten years is a code requirement but it's never enforced and seldom done, for example. "It's a big undertaking and it's very hard to convince a VP of finance to spend $300,000 on something that you can't see and that isn't broken."

So Zarhi thinks we need to talk about "proactive" maintenance instead: "It sounds ➔

THE GLOBAL SUPPLY CHAIN JUST STOPPED BECAUSE EVERYONE WANTED THE SAME PRODUCT AT THE SAME TIME, EVEN THOUGH THEY DIDN'T NEED IT AT THE SAME TIME

MATHIAS ELMFELDT, WSP

very similar, but one is reacting to problems and the other is looking for the problems. There's a huge difference." WSP has developed a "risk-informed" facility condition assessment (RIFCA), to better help owners target investment where it is most needed. "A traditional FCA just says 'your building is collapsing, it's going to cost you millions of dollars to repair'. With a risk-informed assessment, we can say 'that air-handling unit

WHEN COVID HIT, HOSPITALS THAT HADN'T BEEN PERFORMING PREVENTATIVE MAINTENANCE SUDDENLY STARTED LOOKING AT THEIR FILTERS OR HVAC SYSTEMS AND REALIZED THEY WEREN'T GOOD ENOUGH

TOMER ZARHI, WSP

is in bad condition, and if it breaks, you will have downtime in surgeries', so there's actually a risk class attached to the condition of the asset. Owners want to know what's going to collapse first and what the risk is." (We'll consider how technology can support more effective building maintenance, and much else besides, later in the series.)

If, and it remains a big if, we do act on all of this, COVID should leave us in a better position to weather future crises. This includes the impacts of climate change — another unprecedented global phenomenon with the potential to cause widescale disruption to human and natural systems. "We know there are going to be more extreme weather events, and we have the opportunity to take the lessons from COVID-19 and extrapolate them out so that we are better prepared," says Kevin Cassidy. "In the grand scheme of human history, this is a short-term problem — we will come through COVID-19, as we have come through previous pandemics. With climate change, we might not." ●

At a building level, flexibility is essential for resilience. This almost always adds cost upfront — but it could save considerably more later on, as we've seen during the pandemic. In the next part of the series, we'll take a closer look at exactly what kind of flexibility healthcare facilities really need, and how they can make the economics stack up.

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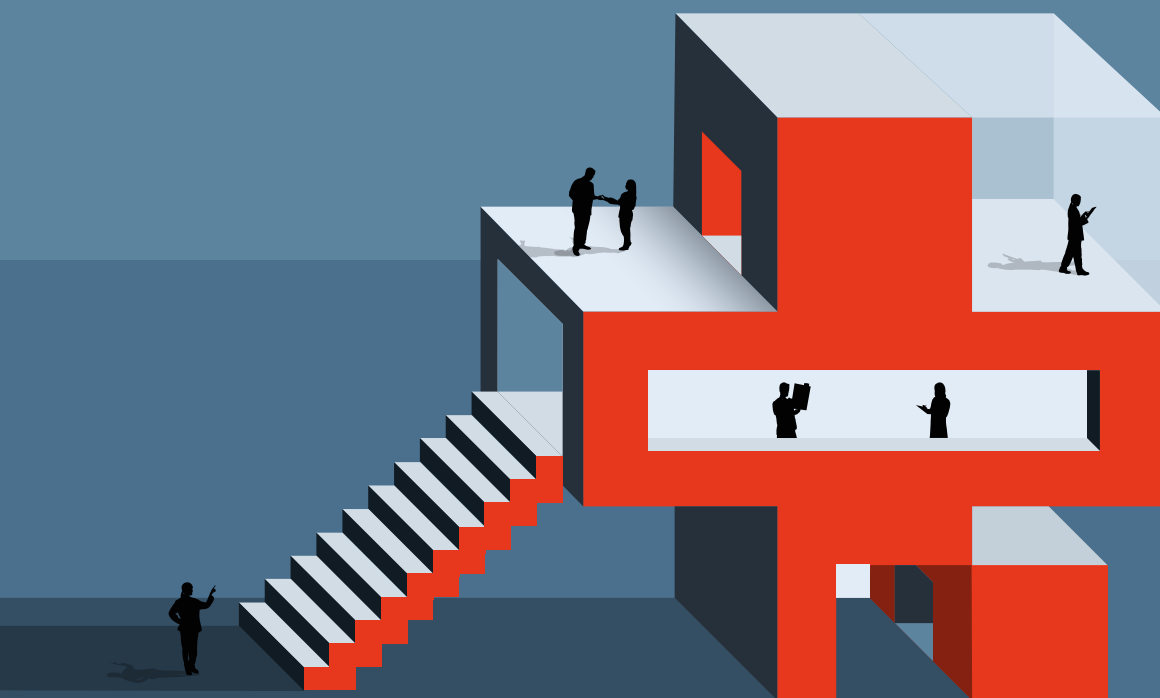
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HOW DO WE DESIGN HOSPITALS FOR AN UNCERTAIN FUTURE?

Flexibility is now the most valuable component of healthcare buildings

Outbreaks of infectious disease are becoming more frequent, as the world becomes more connected and rising global temperatures create more favourable conditions for the transmission of disease. In the previous part of this series, we considered what resilient healthcare looks like in a post-pandemic age, and how we can apply the lessons of COVID-19 to better prepare for other threats to resiliency, such as climate change. In this highly networked world, we have found that a system-wide view is essential for resilience planning. In this article, we're taking a closer look at what resilience actually looks like for individual healthcare facilities. It comes down to one concept above all: viable flexibility.

Even before COVID, there was a growing recognition that buildings of every kind needed to be more flexible, as technological change far outpaces the development cycle. But in practice, any redundancy in a design has often ended up on the cutting room floor, because it adds cost, or complexity, or because it is not compliant with building codes or standards. The pandemic has added powerfully to the case for flexibility — disrupting operations in every part of the built environment, and promising to disrupt markets for many years to come.

In healthcare, a gargantuan effort was required to replan and re-engineer buildings almost overnight so that they could safely cope with COVID-19, and attention is turning to how the switch to "pandemic mode" might be made more easily in future. Greater flexibility would have helped this time. It will make us more resilient in future outbreaks. But it can also help us to overcome existing gaps in provision, to respond to other radical changes that we know are on the horizon, and to changes that we can't foresee.

"All we know is that there will be change," says Suzanne MacCormick, a clinical planner and previously global healthcare lead at WSP. "One of the many lessons of this crisis is that flexibility of space is paramount to enable optimum resilience and provide readiness for the unknown. Instead of 'value engineering' out everything that makes a project resilient, we should engineer in added value."

Facilitating the switch

In many places, the immediate response to this crisis was to provide surge capacity by converting large buildings such as stadiums or conference centres, or by constructing entirely new field hospitals from scratch. For the future, this strategy is shifting to provide extra capacity within hospitals themselves, or in very close

CONVERTING NORMAL PATIENT ROOMS TO ICU ROOMS IS NOT PLUG-AND-PLAY. YOU CAN'T JUST PLUG IN ALL THE EQUIPMENT THAT'S REQUIRED TO KEEP THE PATIENT ALIVE BECAUSE THE REQUIREMENTS ARE VERY DIFFERENT

GARY HAMILTON, WSP

proximity, so that they can more easily access the staff, equipment and infrastructure they need.

This time, the switch to "pandemic mode" has involved reconfiguring hospital entrances and layouts to separate infected and non-infected patients and associated flows of staff, equipment and consumables. Intensive care units (ICUs) were scaled up to care for a surge in critically ill patients, and isolation rooms improvised by installing fans and filters to create negative pressure. For the next time, greater flexibility in both spaces and systems can make the transition smoother and more effective. ICU rooms, for example, need a higher level of emergency power redundancy and a medical gas supply for patients on ventilators, and the hospital infrastructure has to be able to supply a much higher demand for oxygen.

"Converting normal patient rooms to ICU rooms is not plug-and-play," says Gary Hamilton, healthcare practice leader at WSP, based in Washington DC. "You can't just plug in all the equipment that's required to keep the patient alive because the requirements are very different." On one conversion project, he found that the medical gas system could be stretched a little — but that the hospital pipework wasn't big enough to carry the higher loads. "We could have increased that during the design with a marginal effect on the

whole infrastructure cost, and we wouldn't have had a problem. But we weren't designing for a pandemic. This is unprecedented, but it's teaching us that instead of designing to the minimum the code allows, it's important to take a flexible approach." Other relatively minor design changes include installing an extra set of entry doors and extra fire doors between departments, to aid separation and compartmentalization.

But exactly how far should we go? How much should owners and design teams try to anticipate the future, and what level of flexibility is it worth paying for today? Engineers already consider the interplay of emergencies from natural disasters to mass shootings, and the pandemic adds another layer on top. Raising code minimum could make the process easier, says April Woods, a vice president with WSP in Florida. She thinks the impact of COVID will be comparable to that of Hurricane Andrew, which devastated the state in 1992. "That changed a lot of the building codes here and up the coast, for all buildings and also very specifically the resilience of healthcare facilities. In the coming years, I think greater flexibility will just become a standard of care that we have to implement in all of our designs — for example, to allow the engineering systems to be quickly changed to accommodate a pandemic. When those become code-required elements, owners don't have to decide whether to opt into something or not."

Beyond pandemic mode

We don't only need flexibility to be able to go into pandemic mode, we need to be able to move beyond it too. "A lot of the things we are upgrading now are very specific to the virus that we've been fighting, and they're not necessarily a reflection of all the improvements that are needed," says Sarah Wallwork, principal consultant in WSP's UK healthcare advisory team. "We need to design space that can be used for alternative purposes when it's not required for a pandemic. When additional intensive care unit beds are no longer required, you could potentially use that area as a high-dependency unit or a paediatric ICU or as an overflow ward in winter, even for training. As long as you have a building that is built to the required standard and specification, it could be used for a number of things."

Around the world, work is already underway to review building regulations and standards, not only on hospital buildings but the guidelines that govern their operations too. This is an essential part of not only formulating solutions but making them affordable, says Steve Eiss, executive director of facilities development at Banner Health in Arizona. "If you want to create flexibility in design, you also have to create flexibility in use, or the cost curve is going to get bigger and bigger. The rules are very structured on what type of patients are allowed to be in what type of room, so you could spend more money to make certain areas flexible, but lower the types of patients that are allowed to be there, and your utilization ratio is going to get smaller."

Under the current circumstances, any extra spending at all might seem like a very big ask. But COVID is forcing governments and healthcare providers to make major investments today, and we can't afford to waste this opportunity. "In South Africa, there is a long list of facilities that are inadequate or that needed additional capacity even before COVID-19, but there was no funding available," says Jabulile Nhlapo, an associate at WSP in Johannesburg. "The pandemic has brought these challenges to the forefront and it's forcing the public sector to address these running issues. Attaching a field hospital can provide capacity that's been needed all along, so when designing we're thinking about the future use, both in the building materials and the building systems."

Nhlapo has noticed that clients are a lot more receptive to new ideas, such as prefabrication using lightweight steel and modular buildings that can be adapted or relocated after the pandemic. "Right now the facility would be used for a COVID ward, but in future the walls can easily be rearranged in order to create a long- →

IF YOU WANT TO CREATE FLEXIBILITY IN DESIGN, YOU ALSO HAVE TO CREATE FLEXIBILITY IN USE, OR THE COST CURVE IS GOING TO GET BIGGER AND BIGGER

STEVE EISS, BANNER HEALTH

term layout or to provide a general ward." Some structures may be dismantled and individual modules recommissioned as clinics in remote communities. She says that they have been proposing these building methods for some time, "but there is a stigma — if it's not brick and mortar, it's seen as substandard. Now there is a lot more acceptance, which is going to help in the long run. This is the type of innovative thinking that has been required to address the capacity issues we are facing."

In Hong Kong, WSP engineers were among the inventors of a method for building a fully functional isolation hospital from containers in just six weeks. "By using modular integrated construction, we could fabricate these containers quickly and safely off-site, allowing full inspection and fine-tuning before transferring them to the hospital site," says Thomas Chan, executive director of building MEP at WSP. "Not only are the containers stackable, but they can also be converted into a variety of configurations for offices, laboratories and other purposes — all connectable and easily transported by sea or land."

Into the unknown

Further into the future, advances in such diverse fields as telemedicine, wearables, genetics and artificial intelligence will mean hospitals need to accommodate new equipment for diagnostic testing and treatments, while shortening stays or making them unnecessary for all but the sickest patients. "Now hospitals are designed around the need for longer stays in high-acuity settings like ICU and med/surg," says Nolan Rome, leader of WSP's US healthcare practice. "But the baby boomers are going to be the next acute care generation, and we've never seen a patient population that has lived healthfully this long before. We don't know what treatments they will need. Maybe those ICUs will be downgraded in acuity to become transition beds or short-term surg beds — or even exam bays because there is more day surgery."

In a hospital context, it is neither desirable nor economical to equip spaces for any possible future use, especially given the increasing sophistication of medical equipment. Instead, we need to consider specific adaptation scenarios upfront and design for these. "We need to be very specific about the limitations of an area and exactly what it will be able to adapt to," says Gunnar Linder, business area manager at WSP in Sweden and a specialist in engineering healthcare environments. In Gothenburg, WSP designed a highly specialist imaging facility with a modular, demountable

IN SOUTH AFRICA, THERE IS A LONG LIST OF FACILITIES THAT ARE INADEQUATE OR THAT NEEDED ADDITIONAL CAPACITY EVEN BEFORE COVID-19, BUT THERE WAS NO FUNDING AVAILABLE

JABULILE NHLAPO, WSP

facade. All of the operating theatres are located around the perimeter so that one side of each room can be completely opened up to replace the bulky equipment inside. The building systems can also be sealed off, says Linder, "so you can have a construction site within a fully operational ward".

Target value delivery

In the light of COVID, and our heightened awareness of uncertainty, decisions that would have seemed counter-intuitive may become no-brainers. "We need to take more of a life-cycle analysis approach to resiliency decisions," says Rome. "If a resiliency measure costs an extra 10%, does that 10% investment add value over the 50-year life cycle of the building?"

Healthcare owners rarely, if ever, sell their assets, Rome says, so they are in a good position to take a longer-term view. The US is a very competitive, cost-driven healthcare market, but providers are incentivized by government and insurance companies to reduce both length of stay and repeat visits. This has given them an added impetus to go beyond code minimum: "Most owners will do something if it's a six-year payback or less. Anything in the seven-to-ten-year range, they will heavily consider if it helps to mitigate their risk, whether that's infection risk or business case risk."

WSP has been involved in several projects that take an innovative "target value delivery" approach, which breaks a project into component clusters and challenges the team to find efficiencies and added value for each cluster. This has led to greater innovation, such as prefabricated

facades, but also enabled owners to clearly see where any savings from one area could be best invested in another. "If spending on flexibility or facilities can help them to reduce patient visits or operate at the same level with fewer facilities staff, then they'll make that investment," says Rome. "This system is helping us identify long-term resiliency paths, and really weigh and measure them so that they are accepted into the project as opposed to being value engineered out. You're constantly doing that in real-time to make sure that you're driving the value into your project."

He thinks that this model also makes projects themselves more resilient. During the last market crash in 2007/08, many cash-constrained healthcare projects were put on hold for a year or more. "Now, these target value projects are weathering the storm with a little more surety and consistency because the owner understands where and why they're spending their money. If they do have to make a reduction — because there have been three months of revenue lost due to COVID — we try to make it as shrewdly as possible and not affect the long-term outcome. If we cut something now, we may be spending twice as much money to put it back in six years from now when the building is finished."

Target value delivery makes the case for flexibility even more compelling, and puts some numbers behind it. A hospital project may take six or seven years from design to completion, Rome points out. "Let's say you saved 15%, if you wait until the very end to realize the savings, all you really did was lose the opportunity to invest that 15% over a six-year period. If you can bring that to the front and drive it into the value of your project, you're using your money smarter. That's a big investment when you're operating on a margin below 5%." ●

The built environment will always be playing catch-up in the wake of more dynamic systems. But digital technology is right at the forefront. In the next part of the series, we'll consider how "smart" building solutions can help healthcare providers stay resilient in the face of change — and how to ensure the resilience of digital technologies themselves.

WE NEED TO TAKE MORE OF A LIFE-CYCLE ANALYSIS APPROACH TO RESILIENCY DECISIONS. IF A RESILIENCY MEASURE COSTS AN EXTRA 10%, DOES THAT 10% INVESTMENT ADD VALUE OVER THE 50-YEAR LIFE CYCLE OF THE BUILDING?

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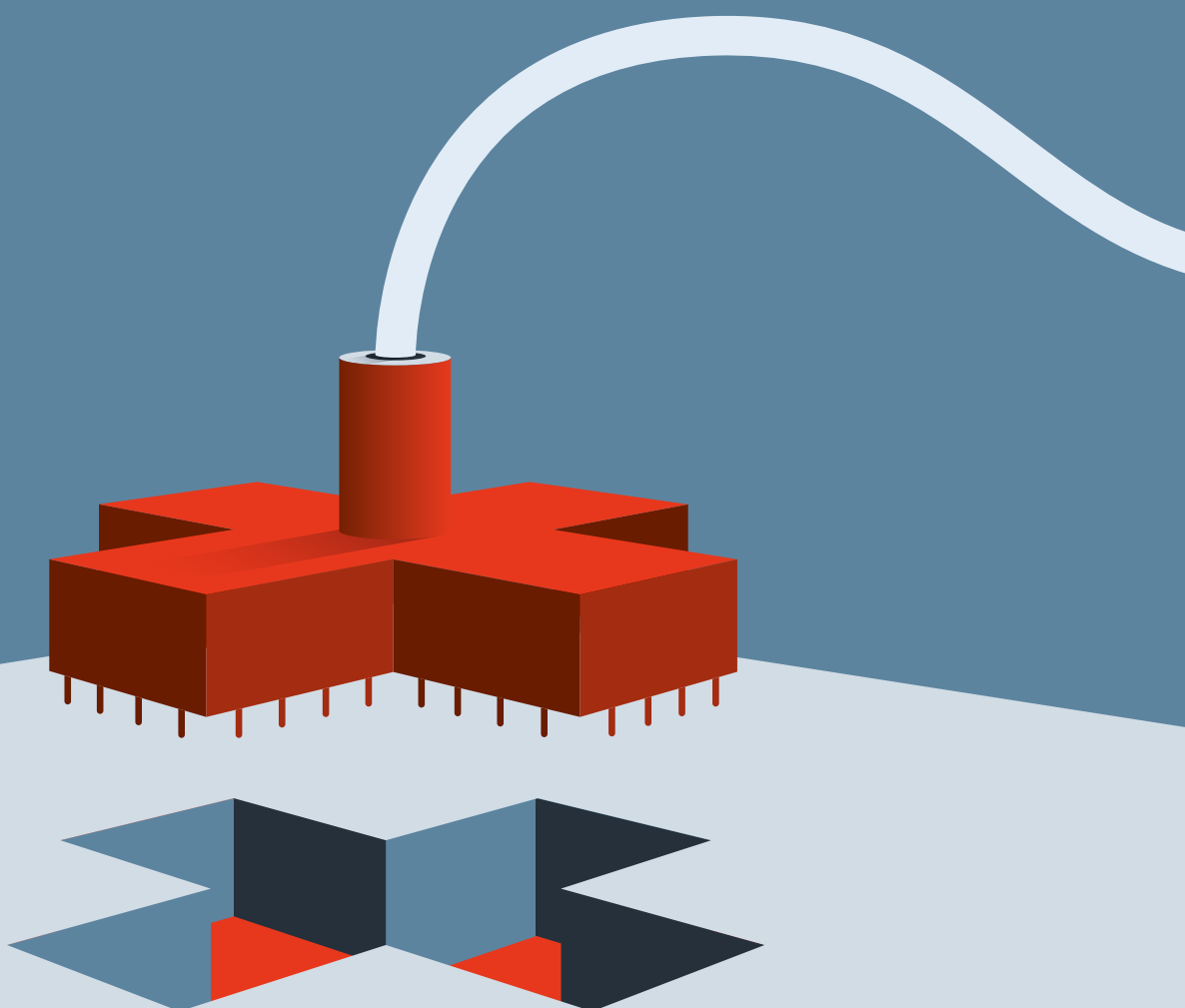**jabulile.nhlapo@wsp.com**

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Continue the conversation

HOW CAN SMART TECH MAKE HEALTHCARE MORE RESILIENT?

Data is the most powerful weapon we have against future crises

2020 is, among many other things, the year the world became obsessed with data.

Since the start of the COVID-19 pandemic, we have become collectively fixated on tools that used to be the preserve of epidemiologists, public health officials and statisticians: the mounting tolls of confirmed cases and of deaths, the sharply rising graph lines and the flattening curves, the mysterious "R" rate that will determine whether or not Christmas is cancelled.

Data has also become one of our most powerful weapons against the virus: some form of contact tracing has been implemented in every country that has managed to bring infection under control, whether manual or digital. In the months and years to come, the analysis of ever larger datasets — so-called "Big Data" — will come to further define our responses, and determine our resilience to future crises.

So far, we have barely scratched the surface, says Michael Pietrzkiewicz, electronics engineering technologist at WSP in Alberta, Canada. "The more data you can gather over time, the more accurate it will be," he says. "If we want to have resilience on-the-fly, we need to be comfortable that the data is correct or we're not going to react to it. Big data has actually played very little part in our response to COVID, partly because this isn't an area where enough has been accumulated. What this has actually reflected is how far we are from having a connected world."

To look at it another way, COVID has given us a glimpse of the enormous potential of data to help us rise to future challenges. One of the most valuable, and rapidly expanding, datasets will come from the "smart" devices, equipped with sensors and network connections, that are being rolled out across buildings and cities. By collecting and aggregating information about the environment and the way we interact with it, these technologies offer a new level of insight that could dramatically improve our ability to foresee and react to events.

Few sectors stand to benefit more than healthcare, a data-rich sector on the cusp of a digital transformation.

Healthcare's information revolution
Vast amounts of information flows through a hospital, but only a tiny fraction of it is has ever been analysed or acted upon — until now. Health informatics — the clinical application of data and digital technology — is one of the global healthcare sector's fastest growing fields. "There has been a massive push on informatics in the last 12 months, in every part of the hospital, and informaticians

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MICHAEL PIETRZKIEWICZ, WSP

are going to drive a complete change," says John Wall, principal technical advisor at Metro North Hospital and Health Service in Brisbane, previously principal technical consultant to Queensland Health in Australia. "Smart projects fail because they don't get to the heart of the way that humans do things. That's the role of the informatician, to be the bridge between IT and the clinicians — they know enough to talk to the IT people, and they understand how to collect, manage and validate research data, and how it can be applied to help make better decisions."

Wall is currently leading the IT design for the redevelopment of Caboolture Hospital. As a regional facility, the tech is less ambitious than the A$2bn tertiary teaching hospital he completed a couple of years ago, where a fleet of pharmacy robots roam the corridors. But on this project, he's finding that the staff are much more willing to embrace the possibilities. "With COVID, everyone's had to learn to adapt and be agile. Normally in healthcare, the staff are too busy, but there's been a real change in the dynamic over the last six months. There has been so much more ownership and interaction, and people are more open to working through the solutions and being a part of them."

Resilience through data
At the heart of all smart hospital solutions is a robust digital infrastructure. In physical terms,

→ this means installing wires — to support a dense wireless network — and sensors, which can collect data about the environment and track the location of electronic devices such as smartphones and RFID tags. Once that basic network is in place, it can be used for many things, from alerts for malfunctioning systems, to mapping people, equipment and supplies, to the digitalization of hospital processes and flows.

This can support resilience — the ability of a hospital to operate safely during a crisis — in many ways. Reliable location data could help maintain two different streams for infected and non-infected patients and associated equipment, for example, and manage stretched resources more efficiently. Advance warning of building system failure — from machine-learning analysis of sensor data — would enable maintenance teams to avoid outages. Supplementing the human workforce with robots, to clean or deliver supplies, reduces the risk of disease transmission and minimizes exposure for caregivers and patients.

"Autonomous guided vehicles can be used to transport food and medicine, so hospital staff don't need to go into the ward," says Thomas Chan, Executive Director of Building MEP at WSP for the China Region. He is part of the team designing a smart hospital in Hong Kong, which will use robots to both enhance infection control and solve an acute shortage of workers. They will also apply artificial intelligence to monitor MEP systems and enable predictive building maintenance. "The deep-learning machine embedded in the robots will analyse operating data to check the condition of the equipment," he explains. "If part of the plant system seems to be in poor condition, the building management system will alert the engineering staff and help them locate the problem so it can be fixed, avoiding any interruption in services."

At Bon Secours Mercy Health, a healthcare system with 35 hospitals across the eastern US, director of infrastructure Jonathan Hunley is creating a standard sequence of operations that will be used across all of its facilities, including a "pandemic mode" setting to turn an entire emergency department into a negative air environment. For a new hospital in Virginia, he intends to go a step further. "We are looking at taking all these different smart technologies — building automation, power, lighting, nurse call, patient logistics, security — and combining them into one system where I can monitor everything in real-time. I want to get to the point where I can monitor indoor air quality, and put different control sequences into motion if we see anything spiking."

During COVID, the ability to modify facilities quickly and efficiently has been found to be a very important part of resilience (we discussed building flexibility in detail earlier in the series). In a hospital where spaces are highly specialized, physical changes have complex repercussions. A technological overlay, on the other hand, is far more adaptable.

In Queensland, there is a shift to replace televisions in patient rooms with a "bring your own device" policy, supported by a free high-speed wifi network. "You can do FaceTime, Netflix, GoToMeeting, Zoom, or you can open up the Queensland Health app, put your patient number in, and get access to different services or order your meals," says Wall. This provides a better patient experience, so aiding recovery, he adds, but it also allows new services or information to be added from a central hub. Ditto digital signage — it's much easier to change routes through a hospital by reprogramming displays and wayfinding apps than having to manually alter every sign.

Knowledge is power

But technology's single greatest contribution to resilience may come down to the way it can make the complex flows within a hospital far more transparent.

At Sydney Adventist Hospital, the largest private facility in New South Wales, passive RFID tags like those used in logistics or retail are affixed to patient IDs and medical devices. This allows clinical staff to follow patients' treatment journey on a digital display, and rather than nurses having to manually enter the time of a patient event — such as being wheeled in or out of surgery — an accurate reading is automatically added to their electronic medical record. "You can

SMART PROJECTS FAIL BECAUSE THEY DON'T GET TO THE HEART OF THE WAY THAT HUMANS DO THINGS

JOHN WALL, METRO NORTH HOSPITAL AND HEALTH SERVICE IN BRISBANE

view this through the lens of resilience, but really it's about efficiency, management visibility and staff empowerment," says Barbara MacKenzie, who oversaw the project as IS operational and infrastructure manager for Adventist HealthCare. "In stage 2 theatre recovery, they loved it because they could see exactly what was coming at them. In the emergency department, they loved it because when someone came in and asked where their mother was, they could glance up at the board and say 'she's in radiology right now — no, actually she's on her way back down in the lift'."

The next level would be to build intelligence into the system. In an ideal world, clinicians too would be tagged, though this is a sensitive issue for the workforce. "When you know time and place for people and objects, you can infer a lot of information and start to build a tapestry about what's occurring," says MacKenzie. "From the fact that a patient is in that bed at that time, you can infer that an activity is happening or should be happening. You could see that there has been a nurse with them for five minutes, and an IV pump . Or that no one's been near them for 40 minutes, so you could alert that it's time to check on them."

In the future, machine learning and artificial intelligence could support better decision-making in real time — for example, by matching patient requirements to staffing capacity. "The system could then say that a patient should be sent to bed 14 on ward 2 after surgery, because nurses one, two and three have a particular skill set and the cardiologist is going to be there," says Roneel Singh, director of technology systems at WSP in Melbourne. "If several nurses call in sick, the rostering and facilities systems could together work out whether some beds should be closed down or how staff could be rotated."

He believes that the strongest resilience will come from combining data from many different systems — clinical, administrative, building — into a "three-dimensional" database. "There is amazing technology in hospitals but very rarely is it applied holistically or used to solve problems across the entire facility. It's that extension of the data that we need. Data resilience is about setting up a workflow that could help people who are already under an immense amount of pressure to make some of those clinical decisions."

Resilient systems: the essential prerequisite
All of this will only be possible if the technology itself is resilient. There are no shortcuts, says MacKenzie. "The smart technology is the icing on the cake and it will only be resilient if every

AUTONOMOUS GUIDED VEHICLES CAN BE USED TO TRANSPORT FOOD AND MEDICINE, SO HOSPITAL STAFF DON'T NEED TO GO INTO THE WARD

THOMAS CHAN, WSP

single layer in the technology stack is in good working order. A digital hospital is only as good as its connectivity." In her new role as CTO at Healthscope, a private hospital provider with 43 locations across Australia, she is starting from scratch again to build "digital ready" infrastructure. She groups the components into the core, connectivity — cabling, transport layers, network — and the user experience. The network needs to be a single, converged entity, with redundancy, high availability, security and no unmanaged devices or entry points.

Older, legacy equipment makes all this harder to achieve, but it's not insurmountable. The network core must be modern enough to support software-defined networking, which replaces physical boundaries with virtual management. This trend has commoditized the hardware itself: "So instead of two big expensive pieces of equipment, you can now have half a dozen that are much less expensive, with a highly capable software layer." Upgrades can be targeted at the weakest points, and the older, dumber components moved out to the edge of the network.

Healthcare networks cannot afford to have any weak spots, warns Terri Govang, WSP's director of strategic security + technology. It may be costly to rewire a building or install new conduits, "but mitigation costs pale in comparison to the total cost of a data breach, especially if that breach includes patient information. There is nothing more personal than that." According to software company Emisoft, 764 healthcare providers in the US were subject to a ransomware attack in 2019, part of an "unprecedented and unrelenting barrage". Aside from reputational damage and loss of personal data, a system outage can have tragic consequences in the real world — in September, a German woman died after hackers caused →

→ the failure of IT systems at a major hospital in Dusseldorf. The biggest vulnerability is not new systems, but old ones that are obsolete or no longer fit for purpose, something for which public agencies are notorious. When the 2017 WannaCry ransomware attack exploited a vulnerability in older Windows machines, the UK's National Health Service was among the worst affected organizations worldwide.

There can be no compromise on security — but neither can it be at the expense of the user experience, says MacKenzie. This is critical to success, and access must be fast, easy and consistent across devices. Above all, user interactions with new technologies must work smoothly from day one. "If you roll out something that almost works, people stop using it because it's too much of a risk. Every single piece of technology or workflow change that is imposed on people, you need to ensure there is value in it for them. Once you've built trust through delivering on the technologies' value proposition, you reach the point where resilience happens as an organization — it's the people and the digitally enabled processes that together form the resilience."

Smart technologies only have value if they complement human processes, agrees Nikolaus Varchmin, a healthcare project manager with WSP in Munich. "Very often when we think about technology in healthcare, it's in terms of either/or — either people or robots — rather than 'and'. But you only get the benefits if you look at the human factor and the infrastructure together, and you really understand how a hospital functions. We need progress in both directions."

In other words, technology — and the data it channels — can only support resilience if it supports humans themselves. ●

THE SMART TECHNOLOGY IS THE ICING ON THE CAKE AND IT WILL ONLY BE RESILIENT IF EVERY SINGLE LAYER IN THE TECHNOLOGY STACK IS IN GOOD WORKING ORDER. A DIGITAL HOSPITAL IS ONLY AS GOOD AS ITS CONNECTIVITY

BARBARA MACKENZIE, HEALTHSCOPE

During this series, we have explored solutions for increasing resilience in healthcare at a system level, through the flexibility of individual facilities, and by using data and smart technologies. But there's another kind of resilience that trumps them all: human resilience. The ability of people and communities to withstand catastrophic events is dependent on many factors, including underlying levels of physical and mental health, the quality of living and working environments, and existing support networks. To improve resilience in this domain, we need to look beyond healthcare, to the places where most of us live: cities. We'll look at how the built environment can contribute to healthier, more resilient populations in the final part of the series.

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CITIES AFTER COVID-19: HOW CAN WE CREATE A POSITIVE LEGACY FOR HEALTH AND WELLBEING?

The pandemic has given a stark illustration of how the built environment affects our health, but also shows the potential for change

The COVID-19 pandemic has already severely depleted our physical, mental and emotional reserves. Even if the most ambitious timescales for a vaccine are met, it's clear that the fall-out will last for many years to come, not only from the disease itself but from the indirect impacts of lockdown, economic crisis, disrupted medical treatment and social isolation. It is also becoming clear that those who started with fewer resources and shallower reserves are suffering the most.

In this series about healthcare after COVID-19, we've considered how to improve resilience from many angles — at a regional, national or system-wide level, by making individual facilities more adaptable, and through the exponentially increasing quantities of data that healthcare environments produce. But the most important source of resilience lies within people themselves: as caregivers, as problem-solvers and, more fundamentally, in the capacity of individuals and communities to cope when crisis hits.

COVID-19 has strongly reinforced what researchers already knew: that healthcare itself plays a relatively small role in the overall health of populations. The conditions in which we are born, grow, live, work and age — known as the social determinants of health — are far more influential. By confining us to our immediate surroundings, the pandemic has made some of the root causes of ill health — as well as the inequities between communities — all the more apparent.

But it has also given us an insight into what healthier, happier places might look like, and the potential for a new kind of urban design, refocused around wellbeing. Applying these lessons to our cities would not only aid the long recovery from COVID, but shore up resilience against whatever the coming decades bring.

How the built environment affects health
The social determinants of health are not a new concept, but they are a growing preoccupation for a healthcare sector that has traditionally focused on treatment. Lord Nigel Crisp, a former chief executive of the UK's National Health Service, has just published a book called *Health is made at home, hospitals are for repairs*. "There's been a massive increase in life expectancy, and we've seen some of the biggest gains from healthcare," he says. "Now we need some big gains from prevention, and we need to refocus on a third thing that has rather been forgotten: health creation. Healthcare is important, but it's only 10% of health. Health is about your relationships, your context, your environment, about being everything you could be." Crisp uses Aristotle's

HEALTHCARE IS IMPORTANT, BUT IT'S ONLY 10% OF HEALTH. HEALTH IS ABOUT YOUR RELATIONSHIPS, YOUR CONTEXT, YOUR ENVIRONMENT, ABOUT BEING EVERYTHING YOU COULD BE

LORD NIGEL CRISP,
FORMER CHIEF EXECUTIVE, NHS

concept of "eudaimonia" or "human flourishing".

Many elements of the urban realm affect our ability to flourish: the quality of the air we breathe, the ease with which we can access healthy food, the opportunities within our neighbourhoods to safely exercise, and to connect with others and with nature. They also influence how likely we are to develop illnesses such as cancer, chronic respiratory disease, heart disease and diabetes. Incidence of these non-communicable diseases is rising rapidly around the world, threatening to overwhelm societies with the costs of healthcare over the coming decades. They are also linked to worse outcomes from COVID.

"The social determinants model is really about capturing the stress loads on people as they age," says Vivienne Ivory, a researcher specializing in social sciences, resilience and public health at WSP in New Zealand. "If you haven't had those stresses that come from unemployment or poverty or living in a challenging environment, then you can cope with the additional stress from something like COVID much more easily."

In particular, the experience of lockdown has shown what a difference our surroundings can make: "We've discovered that things that were seen as nice-to-haves — places to connect, to move around safely, to see the natural environment — are actually hugely important. During lockdown, people who live in nice neighbourhoods really got to know them. Everyone was out walking and saying 'hi' to each other at a distance, and children and families were biking around. But in neighbourhoods that aren't so nice, no one went out because they felt it wasn't safe. These are the populations that have suffered poorer outcomes." This is not just a lockdown issue, she adds: the rise of homeworking will make living conditions an even more significant determinant of health.

The city as a lab
A good first step towards addressing disparities would be to look at where health-supporting amenities are located and identify the populations without access to them, suggests Anna Robak, research and innovation manager at WSP in Canada, and adjunct professor at the University of New Brunswick. "Most municipalities probably know where the gaps are already, but it helps to see it starkly on a map like that. When you overlay health data, you'd almost certainty see that's where the worst impacts are."

Robak compiled a report about how the built environment could support better health for vulnerable populations, which draws together many studies that link increased physical activity with lower rates of non-communicable diseases, and with the design of the built environment. For example, Canadians living in highly walkable areas did significantly more moderate-to-vigorous physical activity than those in the least walkable, while another study in the US state of New Jersey found that children in low-income areas living within 400 metres of a park were 60% less likely to be obese.

It's easy to dismiss built environment factors as a proxy for poverty — correlation is easy to show, but causation is hard to prove, she concedes. "What would be interesting is to look at what happens over time if you do put in a park. Is that enough, or does there need to be something more than that? Does it get maintained if it's in a poor area, is there enough demand if the kids' parents are busy at work and can't take them to the park? There's a great opportunity to learn more."

These are not necessarily major investments, but they may not be a priority for municipalities because they are not facing the rising costs of treating chronic conditions. Robak suggests that a more holistic view would see government health authorities co-fund improvements to the urban realm, and make municipalities responsible for a proportion of health outcomes. "Like it or not, what municipalities do already affects our health," she points out. "The way we invest right now means that our most vulnerable populations are the least healthy because they are further away from parks, →

THE WAY WE INVEST RIGHT NOW MEANS THAT OUR MOST VULNERABLE POPULATIONS ARE THE LEAST HEALTHY BECAUSE THEY ARE FURTHER AWAY FROM PARKS, TRANSIT AND ACTIVE TRANSPORT CORRIDORS, AND THAT PUTS A FURTHER LOAD ON THE HEALTHCARE SYSTEM

ANNA ROBAK, WSP

→ transit and active transport corridors, and that puts a further load on the healthcare system." Those who are most vulnerable to chronic illness tend to have lower incomes, to be older, to be less able-bodied or minded, to belong to First Nations or other minorities, be a recent immigrant, or to live in remote or rural areas.

Changing behaviour

It's one thing to provide health-creating amenities, it's another to get people to use them. COVID achieved overnight what city planners and doctors had been trying to do for decades. As indoor activities were restricted, there was a mass exodus as people of all ages went outdoors to exercise, to socialize or just to pass the time. Rates of walking and cycling soared, as a safer alternative to crowded public transport.

"What COVID has taught us is that there is a willingness to change behaviour, but also what we can accomplish when behaviour does change," says Rasmus Duong-Grunnet, director at Gehl, a Copenhagen-based design and analysis firm. "At a very fundamental level, we should look at how we can use this momentum." Copenhagen's world-beating levels of cycling are just a behaviour that has developed over time, he points out.

Gehl has developed a data-driven approach to measuring activity in public spaces, so that interventions can be targeted and measured, rather than just based on assumptions. This helped to make the case for the pedestrian-friendly renewal of New York's Times Square and the transformation of 45km of riverfront in Shanghai into continuous public spaces. More recently, it compared outdoor activity — how much, what kind, by who — in four Danish cities before COVID, during lockdown and in the early stages of reopening. In particular, it found that local neighbourhood meeting places were thriving more than ever, both during lockdown and afterwards. The most successful shared certain characteristics: they were walkable and accessible, with a diverse mix of amenities.

This supports the increasingly popular concept of the 15-minute city, made up of neighbourhoods where almost all needs can be met within a short walk, cycle ride or trip on public transport. Melbourne's 2017-2050 land use plan is structured around the 20-minute neighbourhood, while "la ville du quart d'heure" was the centrepiece of Paris mayor Anne Hidalgo's 2020 re-election campaign. "COVID has made it very clear that this is how we should plan cities moving forwards," says Duong-Grunnet. "Big cities, especially cities that have grown very quickly, are exploring local

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RASMUS DUONG-GRUNNET, GEHL

communities much more as a potential solution."

One place looking to do this is the Toronto suburb of Brampton. During COVID, it has seen an influx of Torontonians fleeing their condos for its detached homes with gardens, exacerbating an existing shortage of affordable housing. For the future, it will be promoting higher-density, transit-oriented developments, says City of Brampton policy planner Daniella Balasal. "We're really seeing the benefit of mixed-use communities that include everything people need within a 20-minute walk. We've identified two or three locations and we're working with the community to develop homes with a mix of social services, retail and high-rise buildings." This is particularly important for older people, she adds — Balasal is responsible for Brampton's age-friendly strategy and she says the aim is to build new retirement housing on sites where there are already amenities within walking distance. But how to reconcile higher

density with the desire for a backyard? "We can meet some of those preferences in innovative ways. Shared community gardens are a great alternative, or parks or POPS — privately owned public spaces — where a developer could make a private space open to the public. I think we'll be redefining public spaces and appreciating them a lot more."

Creating health through mobility

Active travel — walking and cycling — is something of a magic bullet for health creation. "It obviously makes people more active but it can also have a whole heap of mindset benefits as part of the working day and by getting people outside," says Katherine Bright, director of transportation planning at WSP in the UK. "It helps to improve air quality and helps to take cars and congestion out of the city, which makes the streets a much nicer place and more enticing."

But taking space from cars is controversial, and meets with fierce opposition from local traders. This is typically why active travel schemes fail, adds Simeon Butterworth, Bright's colleague and also a director at WSP. "In most transport strategies, the economic viability of the high street takes precedence over the health agenda." COVID abruptly turned things upside down, forcing through changes that would have taken years. In May, the UK government set up emergency funding for active travel measures. Butterworth and Bright have since worked with more than 30 local authorities to implement measures such as adding cycle lanes and reallocating road space.

Active travel is most viable for the first and last mile of a journey, so it needs to be integrated into transport networks, says Butterworth. "For this to have any long-term influence on how we travel, we can't just do it in glorious isolation."

Enter the "mobility hub" — another concept that is fast gaining ground, and which WSP's UK mobility teams are also helping local authorities to implement. This brings together new and traditional ways of travelling — trains, buses, taxis, shared bikes, e-scooters, delivery robots — alongside facilities or services that may be missing in the local area, whether that's a supermarket, walk-in clinic, community centre or parcel lockers. "The idea is to make it easier to travel by sustainable modes," explains WSP associate John Bradburn. "Rather than someone driving to drop their child off at nursery, then driving to work on the other side of town, then to the supermarket and back to the nursery, they might just be able to travel to the local hub to do everything they need and travel to work

from there." "It's about being people-centric and place-centric," adds Toby Thornton, technical director of future mobility at WSP in the UK. "It's grounded in understanding the specific needs of an area and then looking at the gaps this intervention could fill. That might be a lack of access to essential goods, or to education. Some of the components might be temporary so the function of the hub will evolve over time."

With a greater focus on prevention, health systems might choose to invest in apparently unrelated areas, like transport. Mobility and health are intrinsically linked, argues Stacey Matlen, a WSP employee currently seconded to the City of Detroit as a senior mobility strategist. She has a background in public health and has been working on a pilot project to give seniors access to health-enabling activities using autonomous vehicles. "My goal isn't just to demonstrate the technology, but also to demonstrate the business model and the value of transportation to health — to make that causal connection between transportation access and access to ▸

WE'RE REALLY SEEING THE BENEFIT OF MIXED-USE COMMUNITIES THAT INCLUDE EVERYTHING PEOPLE NEED WITHIN A 20-MINUTE WALK … I THINK WE'LL BE REDEFINING PUBLIC SPACES AND APPRECIATING THEM A LOT MORE

DANIELLA BALASAL, CITY OF BRAMPTON

basic services and health outcomes."

Active travel is easier in some climates than others. In the sweltering summer temperatures of the United Arab Emirates, making cities walkable would mean providing some form of shade over the majority of walkways, points out Farah Yassine, WSP's sustainable resource management lead in Dubai. Existing UAE green building regulations do enforce a percentage of shading, and Yassine says that clients are becoming more interested in outdoor thermal comfort as they realize the positive commercial impact of higher footfall, in addition to the health benefits that a connection to nature can offer. Standards such as WELL can be useful for helping developers to understand the features that support health, she says, "but what is really key is that health and wellbeing is a priority in the project brief. Good design that is people-centric will inherently encompass health and wellbeing principles." Yassine believes that communities should be invited to play a much greater role in shaping new developments. Health can mean different things, she points out: "For some people, it might be having a gym in their building, but for others it might actually be having a playroom for kids. We can create healthier places by asking people what works for them, which will ultimately help them to lead healthier lifestyles." Empowering people to shape their communities can have a positive impact on mental health too, she adds.

Designing social interaction

A more people-centric design process would place far greater priority on accessibility and inclusiveness, not only to encourage everyone to move around more but to foster social interaction. This has been one of the great takeaways of the pandemic: just how severely a lack of contact can affect us. Researchers were already discovering a rising trend for feelings of loneliness among those living in big cities. If we don't manage to arrest this, a bleak future beckons.

"If we've learned anything from the last 12 months, it's that our built environment needs to be more inclusive and reflect the world in which we live," says Michael Tyrpenou, principal of social strategy and design at WSP in Australia. "This is an opportunity to recast the role that cities play, and the way that people use them. We need to include a more diverse range of views and lived experience, and we need to challenge the codes and standards that we design to by involving end users in the process."

"Third places" that are neither home nor work — cafes, libraries, park benches — are a good

RATHER THAN SOMEONE DRIVING TO DROP THEIR CHILD OFF AT NURSERY, THEN DRIVING TO WORK ON THE OTHER SIDE OF TOWN, THEN TO THE SUPERMARKET AND BACK TO THE NURSERY, THEY MIGHT JUST BE ABLE TO TRAVEL TO THE LOCAL HUB TO DO EVERYTHING THEY NEED AND TRAVEL TO WORK FROM THERE

JOHN BRADBURN, WSP

way to promote casual contacts, says Vivienne Ivory. "Even a bus can be a third place if you go there regularly and you feel that you belong. Designing for those opportunities will become really important."

Loneliness is often framed as a problem for older people. But we need to worry about the young too, says Ivory. "The uncertainty around COVID, in terms of what it means for the next three months, let alone the next ten years, threatens to disengage our youth in particular. We need to find a way of keeping them engaged because if we don't, society is going to have a real problem." As unemployment rises, the built environment needs not only to make space for young people, but to invite them to help create it. "We need to think about it in a social value sense: how do we design and construct in a way that involves youth, so that they're getting that sense of purpose when traditional paths may not be open to them." In New Zealand, she adds, there is an emphasis on "green jobs" or conservation activities in native forests — could the built environment offer similar opportunities for meaningful work?

Ultimately, designing healthier places is essential to ensure the future of cities themselves. COVID and the growing acceptance of homeworking has prompted many urban dwellers to consider a move out, to smaller towns or rural areas where they can find more space, fresh air and nature. Meanwhile, public transit ridership is down and private car use is rising for short trips,

WHAT IS REALLY KEY IS THAT HEALTH AND WELLBEING IS A PRIORITY IN THE PROJECT BRIEF. GOOD DESIGN THAT IS PEOPLE-CENTRIC WILL INHERENTLY ENCOMPASS HEALTH AND WELLBEING PRINCIPLES

FARAH YASSINE, WSP

increasing congestion, air pollution and carbon emissions. If the pandemic results in a shift to lower-density urban sprawl, it could frustrate our attempts to prevent catastrophic climate change and ecosystem collapse — with consequences for human systems far beyond healthcare.

We urgently need to reframe the debate, says Duong-Grunnet. "The question shouldn't be 'should we live in cities or not', it should be 'how should our cities be designed so that we can live healthy, equitable and sustainable lives in them.'" ●

Continue the conversation

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First person:
reflections on the pandemic response

"I TOLD THE GOVERNMENT, 'I HAVE A PLAN, PLEASE LET ME BUILD IT'"

Dr Lily Chiu is operations director of China State Construction's international medical development branch. Previously, she worked for the Hong Kong Hospital Authority as chief executive of the Kowloon West Cluster, responsible for seven hospitals serving one quarter of the population. In 2003, she was chief executive of Princess Margaret Hospital, which treated one third of all the SARS patients in Hong Kong. She trained as a paediatrician.

I joined the China State Construction Company with a mission to build Hong Kong-standard hospitals in China. Instead I have spent the whole year building quarantine and isolation facilities. When COVID started late last year, we were initially not that worried because the mortality rate was quite low. But around the Chinese New Year in late January, things started getting much worse. With my past experience, I understood that when an epidemic comes, it's a race against time. You will be suddenly flooded with sick patients, and whatever you do, it's too late. I told the government, "I have a plan, please let me build it. Hopefully we won't need it, but if we do, then it will be there."

During the 2003 SARS outbreak, I was given three days to convert a 1200-bed acute general hospital into a designated SARS hospital. The preparation work involved transferring out all existing non-SARS patients, and converting all 912 beds, including 74 in intensive care, into SARS beds for both adults and children. It was a very hard battle. On the first day of designation, nearly 100 new SARS patients presented to the A&E. I had made a wrong assumption: I thought

SARS patients would only deteriorate seven days after admission, which meant I would have seven more days to prepare, especially the ICU. But unfortunately, it turned out that many of these patients had contracted SARS nearly a week before, and some were already very ill. You can imagine the chaotic situation of a hospital suddenly flooded with nearly 30 highly infectious ICU patients in one day, many requiring ventilation support. Infection control measures were not clearly established then. For the whole designation period, my hospital admitted over 600 SARS patients, with more than 40 requiring ICU care. SARS taught us a very painful lesson. Post-SARS, this experience was shared in many different forums and media, in the hope of alerting people to the need for pandemic preparedness. But unfortunately history has been repeated in 2020. Globally we saw how every country's healthcare system collapsed under the COVID-19 pandemic, with a similar outcry from the healthcare staff.

We were more or less the first company to start building quarantine camps for contacts of COVID patients. Concerned over the potential spread of the virus early in the Chinese New Year holiday period, we started planning to build quarantine camps before getting clear instruction from government. We searched on Google Maps for potential sites. The first was a basketball field on an existing campsite. Our plan was to use modular integrated construction (MiC) to build 118 air-conditioned single units, each 3m by 6m, equipped with an en-suite toilet and shower. They were fully prefabricated in the factory by our company in mainland China. We needed to excavate trenches in the site and put in pipelines. Then, when the MiC units arrived, all we had to do was connect the electricity and the pipework and install the aircon. We worked round the clock — the whole mission was counted in hours not days. In total, it took 600 hours from design to completion, and became the industrial standard for subsequent camps. By the end of this year, we will have handed over 2000 units across Hong Kong. We are currently using the knowledge that we've gained to build a temporary infectious disease hospital using MiC.

The important thing about infection control is to clearly delineate clean and dirty. With COVID patients, the air they breathe out could be contagious, and it is also known that the faecal material has a very high viral load, so the sewage discharge is very hazardous. The design layout has rows of units side by side, with each row facing another back to back. The front entrance is clean, and the back is dirty. Only maintenance staff can enter the dirty corridor at the back between two rows, and the units do not face each other directly, so that the exit airflow is not sucked into the next one. During the construction phase, the campsite was already functioning as a quarantine camp for close contacts of confirmed COVID patients, with staff in full PPE patrolling around the worksite. This of course scared our own site staff. My role, as the medical professional on the team, was to reassure them. We taught them about handwashing and wearing masks, and provided meals and point-to-point transportation to minimize contact with COVID patients. I told them, "You are much safer working here than taking a bus or the MTR as long as you abide by all the infection control measures."

Following the quarantine camps, we became involved in converting an exhibition hall into a community treatment facility with nearly 1,000 beds. It is for newly confirmed COVID patients who are independent and with very mild symptoms. By triaging patients to appropriate healthcare settings, we can reserve valuable hospital beds for those who really need them.

When you're fighting a pandemic, it's critical that you protect your staff and think about them first. Healthcare workers are the key

SARS TAUGHT US A VERY PAINFUL LESSON. POST-SARS, THIS EXPERIENCE WAS SHARED IN MANY DIFFERENT FORUMS AND MEDIA, IN THE HOPE OF ALERTING PEOPLE TO THE NEED FOR PANDEMIC PREPAREDNESS

ALL PROFESSIONALS SHOULD SHARE KNOWLEDGE FOR EVERYBODY'S GOOD. THIS IS ABOUT HUMANITY, NOT JUST A SINGLE COUNTRY — WHAT IS A PANDEMIC BUT AN EPIDEMIC WITH A PASSPORT?

players in a hospital. We need to reassure them that it is safe to work there. In the community treatment facility, we segregate a red zone for patients and a green zone for staff. Staff working in the patient areas are fully gowned and when they go back to the green zone, they gown down and pass through disinfectant booths. In the future, technology will be very important to minimize unnecessary contact. Here, we used remote control monitoring and telehealth measurements — every patient takes their own blood pressure and oxygen levels and the data is passed back to a control centre in the clean zone. We also put in CCTV for patient monitoring, minimizing unnecessary staff contacts with patients. There were a lot of arguments about patient privacy, but the staff wanted it. When building hospitals nowadays, we always think about patient privacy — a patient on a stretcher shouldn't have to mix with the public. In the future, we should venture into thinking about a better flow from clean to dirty to dirtier, and how to better segregate patient and staff areas. Fresh air is always best — but in an urban area where all the buildings are so close together, windows can't be opened and it's all aircon, can we change something like that?

No one can give a good answer on the future of healthcare facilities, except that we have to be prepared. Hospitals of the future will have to combine facilities for "peacetime and for wartime". In many parts of the world, they are thinking about building in "soft" space. Normally this would be offices which can eventually be turned into hospital beds. But it might be a huge outdoor car park, where you lay down all the pipes for water, electricity, sewage, so that they're already there if you need to suddenly expand. The other possibility is to build in more isolation facilities — at least two or three negative-pressure isolation rooms in each ward, or maybe build in the potential so that you can convert facilities to negative pressure very fast.

We can fight COVID, but we have to be proactive. We cannot go back to the past. These are soul-searching thoughts that this pandemic brings about, and it's too much for one person to think about. All professionals should share knowledge for everybody's good, so that we grow together. This is about humanity, not just a single country — what is a pandemic but an epidemic with a passport? So the world really has to work together. I think that's the main lesson that we have all learned from COVID. ●

"PEOPLE WITH COVID SYMPTOMS HAD NOWHERE TO GO … WE HAD 21 DAYS"

Dan Hurley is WSP's principal-in-charge for the renovation of the Newton Pavilion, an unused hospital building in Boston, US. **Fernand Tomaz** is project manager, leading the mechanical and electrical engineering design. In February 2020, COVID-19 interrupted a project to reopen it as a state hospital. The City of Boston and the State of Massachusetts ordered its conversion into a 300-bed field hospital for treatment and isolation of the city's homeless — to be ready in just 21 days' time.

DH: We had just finished schematic design when COVID hit and Massachusetts became a hotspot. People without insurance with COVID-19 symptoms and the homeless had nowhere to go for testing, treatment or for isolation during recovery. The authorities decided to resurrect the Newton Pavilion as a field hospital, but the place had been unoccupied for close to two years. We were part of the team involved in transforming it into the Massachusetts State Hospital, serving the local population and homeless people.

FT: We had 21 days to reactivate the building systems for emergency temporary occupancy. Once the spaces capable of accommodating beds for treatment and isolation had been identified, our WSP team evaluated what work was needed to fix the dormant MEP and fire protection infrastructure.

We left no stone unturned — or unsanitized — before the building was declared operational. A critical consideration was determining which of the existing air-handling units could be reused to ensure air was cleaned and secured for patients and medical staff. We realigned the overall pressure differentials between occupied and unoccupied spaces by adjusting air-handling units and exhaust fans. New parts and filters were installed, tested and balanced for air distribution and exhaust fans providing 100% fresh air in all occupied stations. We installed control software and appointed a qualified operator to ensure the functioning and maintenance of the system. We also confirmed that the steam-heating distribution was fully operational, checked valves at converter units and tested the chillers and pumps, making repairs where necessary. Water pipes, sprinkler systems, emergency lights, fire alarms, plumbing systems, sump pumps and IT networks were among the systems that were installed, cleaned, tested and approved.

DH: 700 patients were treated between April and early June, before the hospital closed its doors when the infection rate in the state came down. While the hospital buildings and equipment were deep-cleaned and mothballed, we reverted to our primary role as MEP engineers for the base project — the conversion of the state hospital. We are now moving into the construction design stage.

FT: The COVID experience has stimulated a rethink on how we can design facilities, and COVID mitigation will be an integral part of the project. We are in the process of including some infection control measures in the base design that would be activated when and if we are in a pandemic mode. These include increasing outside air, air changes and filtration, part of a holistic approach to making the hospital COVID-secure, alongside such measures as hygiene, PPE and social distancing. In this, we are very fortunate to be able to draw on the expertise of our colleagues within WSP who are leading authorities not only in helping hospitals across the US convert spaces into COVID treatment wards, but also in the provision of infectious disease facilities.

DH: Apart from the technical learnings, the greatest experience coming out of this project was the commitment of all our teams to making it happen. We were really concerned for the safety of our staff. This was early days for COVID and we didn't know as much about the virus as we do now. Minimizing potential exposure was a top priority. All staff working on site wore the necessary protective equipment and were fully educated on WSP safety protocols. Everyone knew what they needed to do. Most of all, there was this determination: this was a vital field hospital, and if it did not happen, people wouldn't receive the care they needed.

At this moment, the City of Boston is considering reopening a portion of the building as the pandemic takes hold again in the second spike. This time around, with all the systems installed and ready to go, the building can be reopened immediately to provide a safe and secure place for the homeless this winter. ●

EVERYONE KNEW WHAT THEY NEEDED TO DO. MOST OF ALL, THERE WAS THIS DETERMINATION: THIS WAS A VITAL FIELD HOSPITAL, AND IF IT DID NOT HAPPEN, PEOPLE WOULDN'T RECEIVE THE CARE THEY NEEDED

"RECONCILING ISOLATION WITH THE PATIENT EXPERIENCE IS A CHALLENGE"

Paul Bell is a partner at Ryder Architecture, where he leads the healthcare portfolio. He has worked on projects including the Royal Stoke University Hospital, St Andrews Community Hospital in Fife, and Dumfries & Galloway Royal Infirmary. He is currently leading the design of the 80,000m² redevelopment of Whipps Cross Hospital, a major acute facility in north-east London.

Even as COVID was emerging, we were planning for a pandemic in projects on our drawing board, building on knowledge that we had gained from Hong Kong, including a competition to design a 30-storey extension to the Queen Mary Hospital. Hong Kong had experienced SARS in the early 2000s, so the ability to separate infected and non-infected patients was a major part of the brief. We were already considering how to allow hospitals to adapt their flows and department spaces in the event of an outbreak, so they can isolate and treat infectious patients while continuing to care safely for others.

Managing circulation to minimize COVID contamination starts right at the entrance. On one current project, the care pathway splits into emergency walk-in, emergency ambulance and referral centre patients. All must be streamed separately, with any suspected COVID cases segregated at the earliest stage in isolation bays. Inside the facility, it's about creating the flexibility to change the circulation when the need arises. Rather than a system where people go in and out the same way, a loop allows a single direction of flow around the departments, incorporating lifts and stairs to also segregate vertical circulation.

Reconciling the desire to improve the patient experience with the requirement for isolation is a challenge. Over the last 15-20 years, a key focus has been to simplify hospital design to reduce stress factors, such as the confusion and anxiety caused by the multitude of entrances typical of many older hospitals. Dumfries & Galloway Royal Infirmary is an example of a hospital campus where we sought to design out stress by creating just two, clearly identifiable, entrances for the main reception and accident & emergency. But COVID is teaching us that we must also introduce flexibility for the entrances to be reconfigured to ensure safe circulation during a pandemic.

It's the same with waiting areas: can we create strategies that are safe for a pandemic, without losing the significant improvements that have been made to the waiting experience? We are looking at ways of creating more attractive spaces or systems which, for example, allow patients to wait in dispersed areas such as a coffee bar or outside in a garden until they are called by an app on their phone. A pandemic strategy might involve patients waiting outside the hospital before going to small, localized waiting areas just before their appointment.

COVID has accelerated the use of telemedicine, which is raising some interesting questions about how we manage the acute hospital. For example, clinicians conducting video consultations need space set aside for this activity. Or could this be provided elsewhere, perhaps in an office? What about administrative staff — do they need to take up space in an expensive, complex hospital building? On one project, we are already looking at whether non-clinical staff could be located away from the acute site. In addition to reducing the risk of cross-infection between patients and non-clinical staff, this could free up space and finance, and alleviate other pressures such as hospital parking!

COVID could also be the catalyst for a more integrated service that comprises more care in the community while maintaining general hospital provision. Since the early 2000s our projects have been reflecting this desire to bring healthcare nearer to people's homes and places of work, but I question how effectively this has actually been delivered. At the same time as moving non-clinical hospital staff out of acute hospitals and into offices, we could also introduce day-patient functionality into the high street. Not only could that drive footfall back into town centres, but if an acute hospital were compromised by an outbreak of infectious disease, services for outpatients could still continue — thus increasing the resilience of the health service." ●

AT THE SAME TIME AS MOVING NON-CLINICAL HOSPITAL STAFF OUT OF ACUTE HOSPITALS AND INTO OFFICES, WE COULD INTRODUCE DAY-PATIENT FUNCTIONALITY INTO THE HIGH STREET, DRIVING FOOTFALL BACK INTO TOWN CENTRES

"PANDEMICS ARE NOT 100-YEAR EVENTS. WE NEED TO BE PROACTIVE"

Ontario-based architect **Cliff Harvey** spent 12 years as senior architect for the Province of Ontario, overseeing a major initiative to rebuild its hospitals. In 2014 he moved to the hospital sector to help manage and deliver these complex projects. His current role is chief planning officer for the New South Niagara Hospital, a new 469-bed acute and post-acute hospital that will transform the way healthcare is delivered in southern Niagara.

COVID has disrupted our healthcare system in many ways and so it should disrupt how we think about hospital design. In Ontario, the outbreak of SARS in 2003 led us to change our approach in order to improve the way we dealt with infectious diseases. This placed us in the fortunate position of having new facilities capable of handling COVID patients, particularly in the acute-care setting. Like SARS, the immediate focus with COVID was to separate ambulatory and non-infectious patients from infectious patients. New facilities allowed for this, while older ones didn't — effectively closing their doors to all but the very sick as many outpatient visits were cancelled. However, even in newer facilities, inpatient services were eventually impacted as elective treatments were deferred in order to create inpatient bed capacity for the forthcoming waves.

With the first wave of COVID, the response of governments and health authorities was to focus on building capacity. This was reasonable based on what we saw happening in Italy and New York in the spring, where healthcare systems were overwhelmed. At the beginning of the first wave we searched and found new solutions for temporary spaces to cope with the anticipated influx. This included field hospitals and non-traditional intensive care spaces. We didn't use them all in the first wave of the pandemic. Now that we are in the second wave, with cases approaching numbers not seen in the first, we are starting to activate these spaces, as well as considering transferring patients to less populated facilities.

COVID has made us think beyond designing for patient care, to how the hospital workplace can support ongoing operations. This has to address staff needs, since they are both at risk as well as being, themselves, a potential risk. People infected with SARS were not infectious until symptoms occurred, while those with COVID can be infectious while being asymptomatic, making them harder to identify. In our original SARS pandemic planning, we did not focus on administrative areas, workplaces and staff screening. Now we're asking what social distancing looks like for team and meeting rooms, open offices and elevators. As a result of the current design, many people need to work from home, and everyone is screened before they enter the hospital. Hospitals are not alone in asking what the future workplace will look like.

Hospital design will also be impacted by new norms, not just in healthcare but on a larger scale in the community. At the beginning of the pandemic, we quickly established a new normal and now we're accustomed to washing hands, wearing masks and physical distancing, habits that are integral to the safe operation of all public places. We've had to get used to communicating via video, and we will continue in future because we realize it is convenient and helps us to be more productive. Virtual healthcare is another new norm that wasn't fully valued until the pandemic. COVID has been a major life-changing experience, but I would argue that there are positives to be drawn. If we pick the best parts of what we are learning, we can make our systems more successful.

As we plan and design the hospitals of the future, we need to carry forward the lessons from COVID, as we did from SARS. But can we go beyond that and be ready for the next pandemic-like event? There may be a reluctance to spend money on something that might not happen for another 100 years. To put this in perspective, since the Spanish Flu in 1918 there have been seven major potential threats that could have become COVID-type events — so COVID is not just a 100-year event. We need to be proactive. We should invest in regularly playing out pandemic scenarios to enable us to work through emerging technologies and procedures, build on experience, use them as design exercises and incorporate them into our practices. Knowing what we do now about the long-term socio-economic impact of a pandemic, I can't think of a more valuable investment.

SINCE THE SPANISH FLU IN 1918 THERE HAVE BEEN SEVEN MAJOR POTENTIAL THREATS THAT COULD HAVE BECOME COVID-TYPE EVENTS

"A better normal for health will…"

"... move traditional thinking from patient-focused outcomes to creating safer places for healthcare workers."

Peter Aspinall, WSP

"... be a holistic approach to wellness, including physical, mental, spiritual, and emotional well-being."

Daniella Balasal, City of Brampton

"... see our daily journeys becoming more active, utilizing walking and cycling facilities whilst enjoying the outdoors."

Katherine Bright, WSP

"... keep people out of hospitals and healthy in their communities."

Kevin Cassidy, WSP

"... promote a better future for our next generation."

Dr Lily Chiu, China State Construction

"... recognize the important role that non-health people — teachers, employers, community leaders — play in creating health."

Lord Nigel Crisp

"... be one where consumers have the right to choose digital consultations, with access to digitally enabled records."

Stephen Duckett, Grattan Institute

"... be when we put community at the heart of urban development."

Rasmus Duong-Grunnet, Gehl

"... provide relevant data to support well-informed decisions, without removing the human element."

Mathias Elmfeldt, WSP

"... be an indoor environment where people feel safer with the quality of air they breathe!"

Gary Hamilton, WSP

"... improve the personal resilience of front line workers and patients alike."

Kealy Herman, WSP

"... happen when people stop relying on others to positively impact their own health and make smart decisions for themselves."

Jonathan Hunley, Bon Secours Mercy Health

"... include tailored support for patients and their families — any time, any place."

Mike Lovas, University Health Network

"... involve a greater focus on prevention and individual enablement."

Colum Lowe, Royal College of Art

"... be community-focused solutions that enhance and nurture human flourishing in its fullest sense."

Suzanne MacCormick, clinical planner

"... be a seamless, safe patient experience supported digitally by information, integrated technologies and people."

Barbara MacKenzie, Healthscope

"... hit a new preventive balance in our health lifecycle by integrating built environment and services."

Anna Robak, WSP

"... be curated individual models of care, with better outcomes."

Roneel Singh, WSP

"... provide a more even distribution of health-creating amenities."

Toby Thornton, WSP

"... take advantage of technology and not be restricted by existing practices and beliefs."

John Wall, Queensland Health

"... build on our lived experience of pandemics to ensure robust, innovative and future-ready healthcare facilities."

Sarah Wallwork, WSP

"... mean destigmatizing stress and mental health and empowering everyone to enhance their personal resilience."

Emily Wasley, WSP

"... be realized through designing inclusive spaces that empower people to make informed decisions and fulfil their potential."

Farah Yassine, WSP

"... be an accountable, prepared place where we can heal fast with no barriers."

Tomer Zarhi, WSP

wsp