shine

Fall 2023

Mighty Microbes

The trillions of bacteria that live in our gut could hold the key to a healthier future

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How 3D printing, virtual reality and digital media are changing care

A program that lets families deliver life-saving treatment at home

Honouring Indigenous children and families

BC Children's Hospital Foundation

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At the cusp of discovery

One of the most remarkable outcomes of technological advances is that we now have more ways than ever to peer inside patients. By doing so, we're beginning to gain a deeper understanding of what's causing devastating childhood illnesses that have, for decades, remained shrouded in mystery.

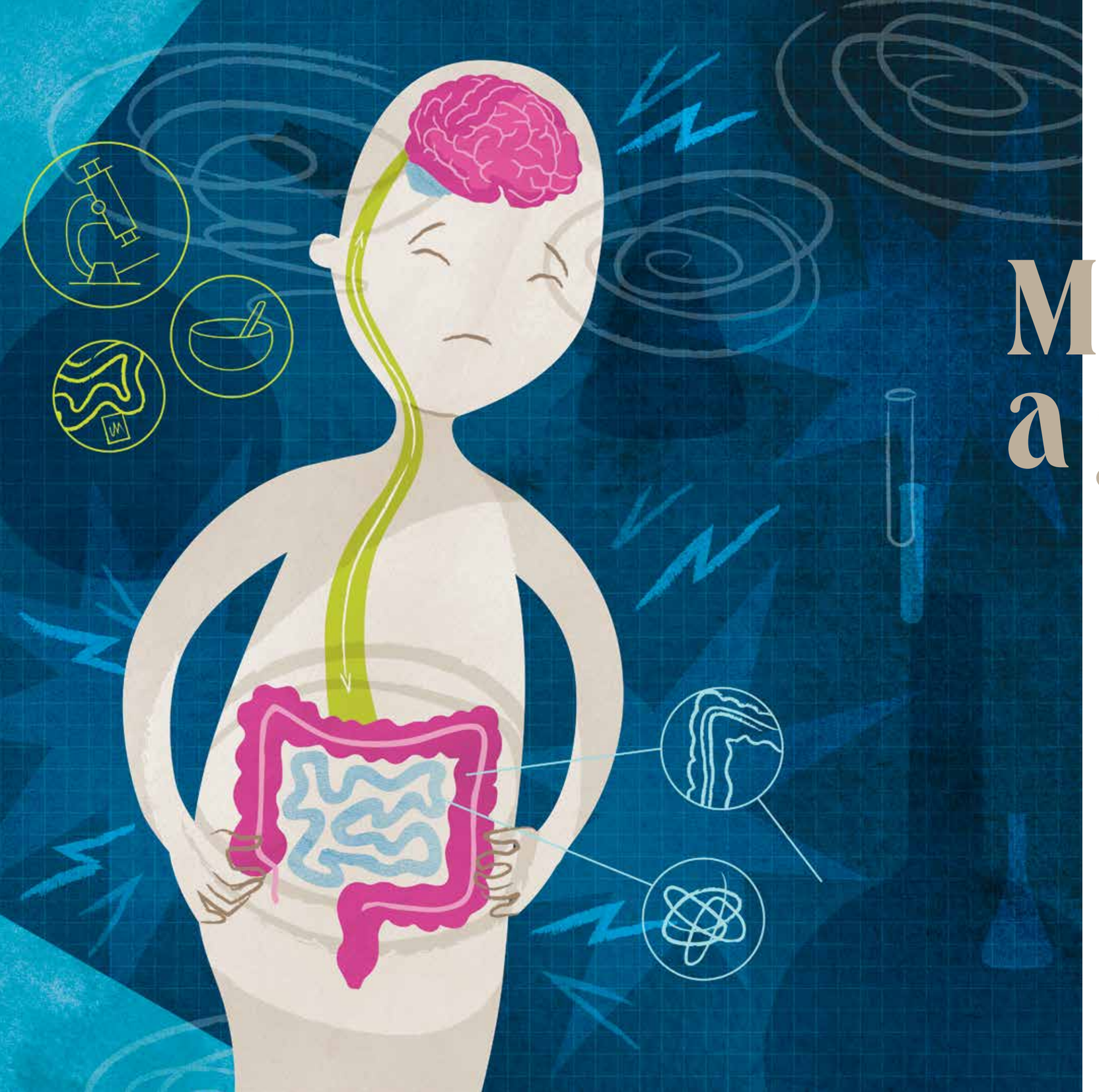
The gut is one example. The digestive system is home to what have long been some of the body's least understood and most overlooked organs. Equipped with novel technologies, visionary minds at BC Children's Hospital are at the global front lines of unravelling its surprising connection to a host of other health conditions—from asthma to mental health. We offer a peek into this transformative research in our feature story.

Technologies are doing more than enhance our knowledge; they are setting whole new standards for care. In this issue of *Shine*, you'll read about an innovative program that's empowering families across the province to administer IV antibiotics at home, as well as how tools like 3D printing and virtual reality are reimagining care across the hospital.

It's an extraordinary time of discovery in pediatric medicine—and we're only starting to scratch the surface of learning about a spectrum of childhood illnesses. The work of the clinicians, researchers and program teams who you'll meet throughout the following pages provide a small glimpse into the immense possibilities that lie ahead of us. I'm so grateful to have you, our incredible community of donors, by our side as we dare to chase our boldest ideas.

With gratitude,

Malcolm Berry
President & CEO
BC Children's Hospital Foundation



"As we've started to discover over the years, there are numerous links between the gut and many other aspects of our health."

— Dr. Bruce Vallance

More than a gut feeling

Researchers are racing to understand how the microscopic bacteria in our gut could tackle big health challenges

The gut boasts an impressive résumé when it comes to a child's overall health. Aside from its main job of processing food, it impacts virtually everything we do. It acts like a second brain and influences how we behave. It serves as a training ground for our immune system. And it even determines our susceptibility to developing other diseases.

"The gut truly is an extraordinary organ," said Dr. Bruce Vallance, an investigator at BC Children's Hospital. "As we've started to discover over the years, there are numerous links between the gut and many other aspects of our health."

To gain a clearer understanding of these connections, leading gastroenterology researchers at BC Children's have directed their attention to something that weighs only a few pounds: the gut microbiome. Part of the digestive tract, it teems with a diverse community of some 100 trillion tiny "creatures," called microbes. While bacteria make up the majority of microbes, it's also home to various species of viruses and fungi.

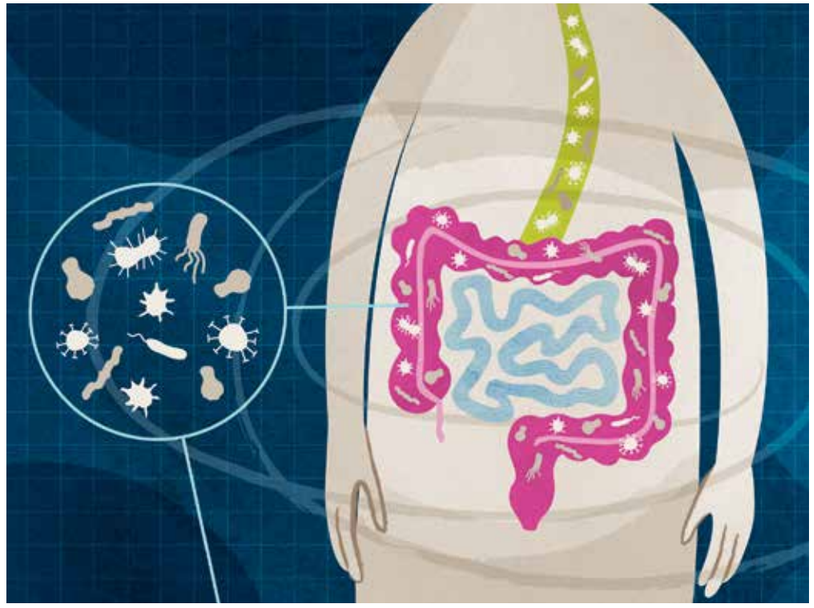
Most of these residents are good for our health. But not all of them. In some children, dangerous microbes lurk in the gut, waiting to expand inside the intestine under the right conditions to cause inflammation.

IT STARTS WITH THE GUT

When the gut microbiome is disrupted, it can have a ripple effect on myriad aspects of children's health. In other words, what happens in the depths of the gut doesn't always stay there. In recent years, gastrointestinal researchers at BC Children's have made massive strides in understanding these implications.

They have a secret weapon in this work: a microbiome profiling core facility, called Gut4Health. Located on the hospital's campus, the state-of-the-art space was made possible through the visionary support of Mining for Miracles.

Here's a snapshot of this work.



UNDERSTANDING THE GUT-BRAIN AXIS

The gut is commonly called the body's "second brain." While many of us don't realize it, it boasts its own independent nervous system—the enteric nervous system (ENS)—which is home to some 100 million nerve cells. Through the body's information superhighway, the vagus nerve, the ENS in our gut is in constant communication with the central nervous system in the brain. Given this, it might not come as a huge surprise that the gut microbiome influences a child's mood and behaviour.

It explains why they may feel butterflies in their stomach, for instance.

Yet, what has been a striking discovery in recent years is the mounting evidence showing the gut's impact on serious mental health conditions. For example, BC Children's researchers have found that anxiety and/or depression occur in at least one-quarter to one-third of kids with inflammatory bowel disease (IBD). Further research has also revealed a connection between gut microbes and autism spectrum disorder.

This knowledge has the power to transform how clinicians treat mental health conditions, since identifying the microbes, or their products, which influence mental health could lead to the development of new microbiota-targeting drugs that combat anxiety or depression.

STOPPING CHILDHOOD ALLERGIES FROM STARTING

Across Canada, one in every three children suffer from allergies.

WITH 100 MILLION NERVE CELLS, THE GUT IS KNOWN AS THE BODY'S

2nd brain

70%

OF THE IMMUNE SYSTEM IS IN THE GUT

THE GUT PRODUCES

95%

OF THE BODY'S SEROTONIN, WHICH REGULATES OUR MOODS

Researchers at BC Children's are at the global forefront of understanding why this is happening—and even more importantly, how to stop it. The answer, they believe, could also be found in the gut microbiome.

In a nearly decade-long study, Dr. Stuart Turvey, a pediatric immunologist at BC Children's, has been exploring how the bacteria that live inside a baby early in life are important for educating the immune system. A recent breakthrough revealed that all forms of childhood allergic disease—eczema, asthma, food allergy and hay fever—link back to the gut. Kids who are at high risk of these conditions appear to have a delayed maturation of their gut bacteria.

These findings stress the importance of a diverse microbiome, which comes from encouraging kids to interact with their environment. It could also open the door to new therapies that can change these bacterial interactions—and potentially even prevent allergic disease entirely.

"Developing therapies that change these interactions during infancy may therefore prevent the development of all sorts of allergic diseases in childhood, which often last a lifetime," Dr. Turvey said.

ELIMINATING INCURABLE GASTROINTESTINAL ILLNESSES

A more obvious area influenced by the gut microbiome are gastrointestinal illnesses. Across Canada, cases of these conditions are rising at an alarming rate among children—including IBD, which consists of Crohn's disease and ulcerative colitis. Although experts are still determining *how*, it's clear that the gut microbiome plays a crucial role in this disease, which causes inflammation that can lead to severe stomach pain, diarrhea and weight loss.

Currently, IBD is managed using a number of different anti-inflammatory therapies. To determine which one is most effective for a child, clinicians must take a trial-and-error approach. This means kids may endure significant side effects, only to learn that a therapy isn't effective in quelling their symptoms.

"We don't know at the outset who is going to respond to one therapy or another," said Dr. Kevan Jacobson, a pediatric gastroenterologist at BC Children's Hospital. "If the first therapy you start with doesn't work, you go to the next one. Or you may start with one therapy, and it works—but a child could lose response to it over time."

REPLICATING THE GUT MICROBIOME, ON A CHIP

The path forward to treating some of the toughest illnesses could lie in the gut microbiome. The challenge is that it has long been one of the least-understood aspects of the human body. That's in large part because of the difficulties in mimicking it outside of the body, as well as the uniqueness of each child's microbiome.

That's starting to change. Gastrointestinal specialists believe a novel technology may hold the answer. It's called gut-on-a-chip, and it allows researchers to create tiny replicas of a patient's intestine in the lab, known as organoids. They can then add bacteria and other microbes or various dietary components to the organoids to gain a clearer picture of what's happening in the microbiome. And perhaps most excitingly, it can serve as a testbed to see how a child might respond to tailored therapies for different conditions, such as IBD.

"We're getting as close to what's going on in the gut as we've ever been able to," said Dr. Vallance. "This work is allowing us to figure out why kids are sick, what the disease has done to their intestine and how we can fix it more precisely."

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— Dr. Bruce Vallance

DETERMINANTS OF MICROBIOME HEALTH

In addition to medication, a range of other factors can shape a child's gut microbiome. Diet is one of them. In her lab, Dr. Genelle Lunken, an investigator at BC Children's, is working to explore the role that personalized nutrition plays in improving outcomes for children with gut-related conditions, including IBD. To do that, she's developing an in vitro microbiome system that mimics the oxygen-free environment in the gut using a patient's stool sample. Different foods can then be added to the system to see how their microbiome responds.

"If we can use the gut microbiome to predict responses to diet in a laboratory setting, we can then develop effective dietary plans that can be provided to patients in clinics," said Dr. Lunken. "This would allow us to move closer towards personalized dietary approaches for our patients, helping to improve overall health and wellbeing."

In addition to this, Dr. Jacobson is exploring the importance of environmental determinants, including pesticide application and poor air

quality, in affecting the health of the microbiome. A recent study determined that population-level exposure to petroleum oil used on orchards and grapes was associated with an elevated risk of IBD. Exposure to greater amounts of fine particulate matter air pollution (the tiny droplets found in smoke and produced by cars) was also found to be a contributing factor in altering the health of the intestinal microbiome.

Putting all the factors together will allow clinicians to study the importance of their relationships and better inform them as to what therapy to choose—and for which patient and at what time.

BC Children's is at the verge of astonishing breakthroughs in understanding the gut.

THE NEXT FRONTIER

Although many questions remain when it comes to the gut, one thing is certain: its job goes well beyond aiding digestion. Propelled by cutting-edge technologies, brilliant minds and an incredible community of donors, BC Children's is at the verge of astonishing breakthroughs in understanding the gut.

Already, the gut microbiome is showing tremendous promise in conquering mental health conditions, preventing allergic diseases and determining a child's susceptibility to cancer—and that's all the more reason to be gutsy about diving deeper into this work.✸

Honouring Indigenous children: past, present and future

BC Children's Hospital strives to be a place where all children receive care and compassion. But we can't build a better future without recognizing our past: Canada's history of colonialism, and the harmful impact of residential schools that Indigenous children and families experience to this day.

As part of an ongoing commitment to reconciliation, a mural was commissioned to welcome visitors to campus—and to signify BC Children's unwavering commitment to Indigenous children and families.

The mural is by Ovila "Ovi" Mailhot, a Nlaka'pamux and Sto:lo artist who is guided by the artistic traditions of his parents and ancestors. Working on this mural was particularly meaningful for him, as he drew inspiration from his mother and grandmother during the creation process. "I wanted to represent the connection between child and mother, and the importance of family healing," said Ovi.

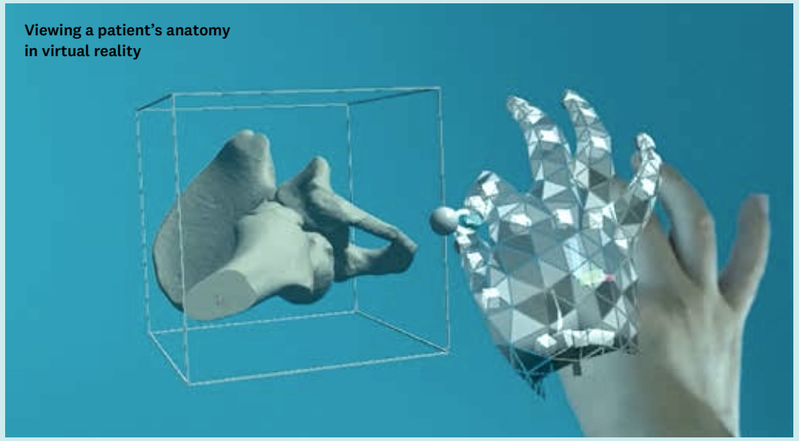
The mural was brought to the Teck Acute Care Centre on September 28, 2023, where the BC Children's and Women's Indigenous Health team hosted an unveiling event in honour of the National Day for Truth and Reconciliation.

The Indigenous Health team, led by Executive Director Sherri Di Lallo, works on a broad spectrum of initiatives. They are guided by four goals: Indigenous-led health care practices and services, cultural safety, collaborative practice and capacity building. The mural is a recent initiative, but other projects include the introduction of additional Indigenous Patient Navigators on campus, the creation of a self-identification process that has improved access to the Indigenous Patient Care Team, and policy work addressing anti-Indigenous racism in BC's health care system.

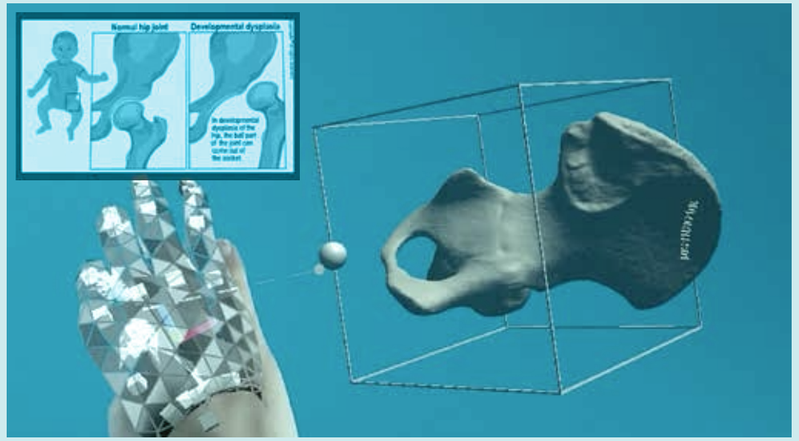
While much of the team's work happens behind the scenes, Ovi's mural, supported by the generosity of donors, is a beacon of warmth for all who come to campus. It's a symbol of hope and comfort for Indigenous patients, and a proud reminder that every child matters.✸

L to R: **David Byres** (President & CEO, PHSA), **Ovila Mailhot** (Coast Salish graphic artist & designer), **Sherri Di Lallo** (Executive Director, Indigenous Health BC Women's and BC Children's Hospital), **Tania Dick** (Director, Cultural Safety & Humility and Clinical Practice, BC Ministry of Health), **Sarah Bell** (COO, BC Children's Hospital)

INNOVATIONS



Viewing a patient's anatomy in virtual reality



Healing with a dose of technology

digital lab

The Digital Lab at BC Children's Hospital began as a simple but promising idea: to use digital innovation and technology to improve the health of kids. Since it launched seven years ago, it's been bringing patient-centered care to entirely new heights. The lab has engaged kids and families in over 100 countries, supports 40+ surgeries annually and engages 25,000+ patients and users each month.

Read on as we peel back the curtain on a few projects in the works—thanks to our community of donors.

01 3D TECHNOLOGIES

Through the support of Kirmac Cares for Kids, surgeons at BC Children's are using three-dimensional replicas of a child's heart to practice highly complex procedures—*before* they pick up a scalpel.

They're not stopping there. In recent years, the Digital Lab has been bringing this technology to other areas of care—like complex bone surgeries. Together with the Department of Orthopedics, they're creating precise digital simulations of procedures using 3D virtualization technologies, which can lead to shorter operative times, smaller incisions and quicker recoveries. They're also designing and printing highly personalized surgical devices that are entirely unique to a child's anatomy to improve precision and accuracy during procedures.

As for what's next, experts are in the early stages of prototyping with printing biomaterials. That may one day allow them to 3D print actual tissues or bone that can be used to support a child undergoing specialized treatment.

02 VIRTUAL AND AUGMENTED REALITY

Whether it's a routine clinic visit or a complex medical procedure, the hospital can be stressful—especially for kids. Take MRIs, for example. Young patients are often intimidated by the unfamiliar room, loud noises and confined space. In a new clinical trial, researchers are exploring how virtual reality can be used for exposure therapy. Through it, a child and their family are immersed in a virtual world that mimics the exact hospital experience, helping them feel more confident.

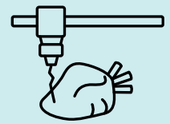
These experiences are created using incredibly high-quality images or videos of the real world, such as a hospital room, operating room or inside the MRI machine. To help orientate patients, they also use actual sounds of machines and even the voices of clinicians.

The best part? The Digital Lab has integrated this with a game-based mobile app that lets kids and families walk through a digital version of the hospital using a virtual avatar—before they enter the virtual reality experience.

03 DIGITAL MEDIA

Technology is also allowing kids and families to understand and manage their conditions in novel ways. Case in point: the Heart Centre Online Patient Education Hub.

Launching this November, the resource gives families living with pediatric heart disease, like congenital heart defects and arrhythmias, access to the expertise and knowledge of the Heart Centre team right on their phone or computer. They can learn about the complexities of heart disease in engaging ways, such as interactive 3D models and custom animations—empowering them to understand the condition like never before.✸



3D PRINTING
Helping surgeons practice highly complex procedures in advance

VIRTUAL REALITY
Immersing kids and families in virtual hospital scenarios

DIGITAL MEDIA
Equipping kids, families and caregivers with the knowledge they need

Navy, age 2 and her parents

Bringing life-saving care to the comfort of home

It was July 9, 2023. A medical team at BC Children's Hospital was working around the clock to support Navy, a 2-year-old with an alarming infection in her liver. After a battery of tests, they discovered the cause: a rare genetic disorder called Chronic Granulomatous Disease (CGD). Her compromised immune system couldn't fight the bacterial infection inside of her.

"It was terrifying to see Navy so sick," said Navy's mom, Charlene. "And then to find out the cause was a rare immune system disorder... it was so much to take in."

"Rare" is not an exaggeration—Navy is the third British Columbian to be diagnosed with CGD in 20 years. Thankfully, BC Children's is well-equipped to deal with rare diseases.

With a diagnosis in hand, Navy's team tackled a complex series of health challenges. Not only did Navy have a serious infection, but the abscess on her liver had caused a coagulated blood clot that ran from her liver to her heart. An extensive recovery lay ahead. BC Children's Hospital became Navy's new home, and her family went through the exhausting but necessary process of shifting their life around her treatment and care. Days turned into weeks, weeks turned into a month. But gradually, Navy's condition improved.

With Navy walking, smiling and laughing like she used to, the family was eager to bring her back to their Langley home—with her care requirements in mind. But there was a catch: Navy still needed a long course of IV antibiotic treatment, which could keep her in the hospital for another three to four months.

That was when the family was introduced to Pediatric IV Outpatient Therapy (PIVOT). The program, which launched early this year, helps patients with serious infections get back to being kids. To do that, PIVOT educates, trains and supports family caregivers in administering IV antibiotics in the comfort of their own home. But it doesn't just help kids. "PIVOT is a confidence builder for families. They're able to take ownership of their child's care and directly support them through illness," said Dr. Tom McLaughlin, PIVOT's Medical Director and lead pediatrician—who was given the chance to chase his boldest ideas through the Hudson Scholars Award Program in Pediatric Medicine.

The PIVOT team is comprised of Dr. McLaughlin and two nurse-clinicians, Rebecca Euverman and Amanda Doucette. They support patient families across BC and the Yukon, both in-person and virtually by phone, email and Zoom. The team also supports local nurses and doctors who provide care to PIVOT patients living outside of the Lower Mainland.

Dr. McLaughlin is grateful to donors who helped power PIVOT. "The program wouldn't be where it is today without the community's support," he explained. "Because of generous donations, illnesses like these don't have to disrupt childhoods. While it may seem like a 'small thing,' it means everything for families to be able to return to life at home."

PIVOT's patient families would agree. Since the program's launch in early 2023, PIVOT has helped patients collectively avoid over 755 hospital-bed days. And as Navy gears up for a bone marrow transplant in the new year, her parents are overjoyed that she's able to be home for a few months. "It's incredible, being able to tuck her in at night at home," said Charlene. "I'm just so grateful."

Navy and her parents at the end of their in-patient stay

"We have parents who are able to support their child's health very directly. A lot of the time, parents see all the technology in the hospital room and think 'how could I do any of this?' But PIVOT uses innovative technologies that are simplified, and we support them through everything."

— Dr. Tom McLaughlin

Navy receiving her injections at home

A day in the life of Navy at home

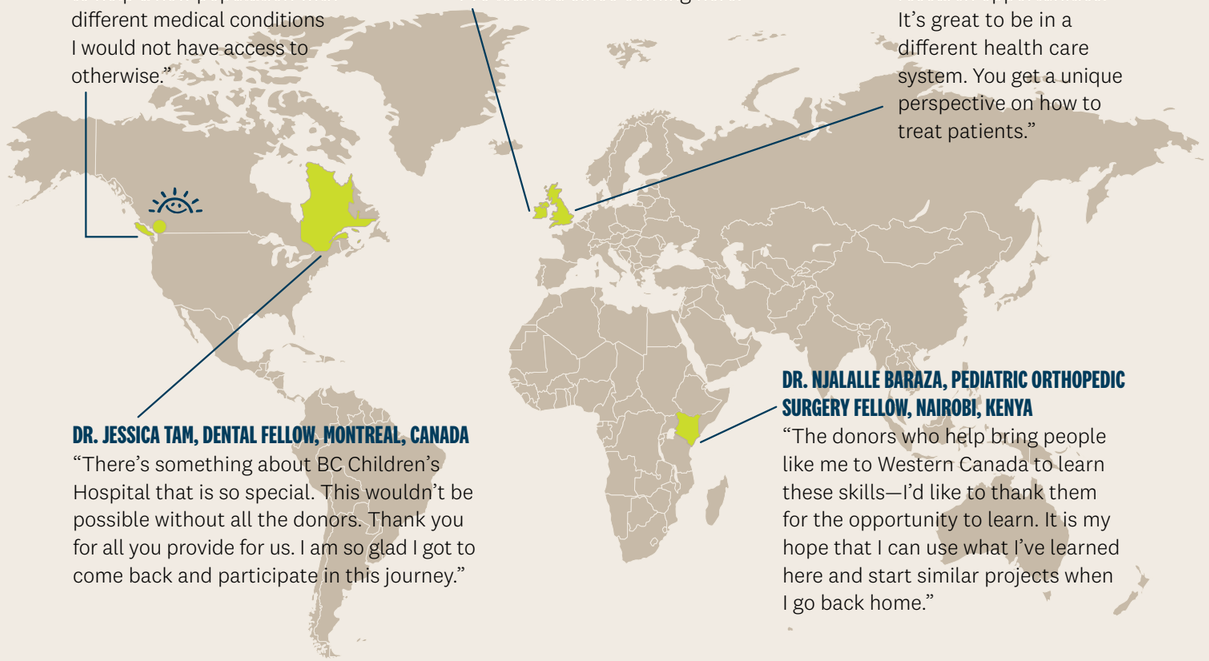
Navy has a unique schedule for a toddler. Here's how her family manages her treatment plan.

7AM Navy takes four oral medications and an anti-coagulant injection administered by Mom or Dad.

3PM Navy takes three more oral medications, followed by an IV antimicrobial run through her peripherally inserted central catheter (PICC). Her PICC allows the antibiotics to quickly reach her bloodstream.

6PM Bath time. Navy's parents work to "waterproof" her PICC.

7PM Navy takes another three oral medications and a final injection for the day.



DR. KARLEY TALBOT, PEDIATRIC PSYCHOLOGY FELLOW, VICTORIA, CANADA
"I've been able to use the neurophysiology knowledge I've acquired through school to help a new population with different medical conditions I would not have access to otherwise."

DR. ELAINE REDMOND, PEDIATRIC UROLOGY FELLOW, CORK, IRELAND
"Next year I am going to return to Cork in Ireland and I am going to bring back everything I've learned since coming here."

DR. RICHARD THOMSON, PEDIATRIC PLASTIC SURGERY FELLOW, LONDON, UNITED KINGDOM
"Lots of clinical opportunities, lots of research opportunities. It's great to be in a different health care system. You get a unique perspective on how to treat patients."

DR. JESSICA TAM, DENTAL FELLOW, MONTREAL, CANADA
"There's something about BC Children's Hospital that is so special. This wouldn't be possible without all the donors. Thank you for all you provide for us. I am so glad I got to come back and participate in this journey."

DR. NJALALLE BARAZA, PEDIATRIC ORTHOPEDIC SURGERY FELLOW, NAIROBI, KENYA
"The donors who help bring people like me to Western Canada to learn these skills—I'd like to thank them for the opportunity to learn. It is my hope that I can use what I've learned here and start similar projects when I go back home."

The experts of tomorrow: from local to global

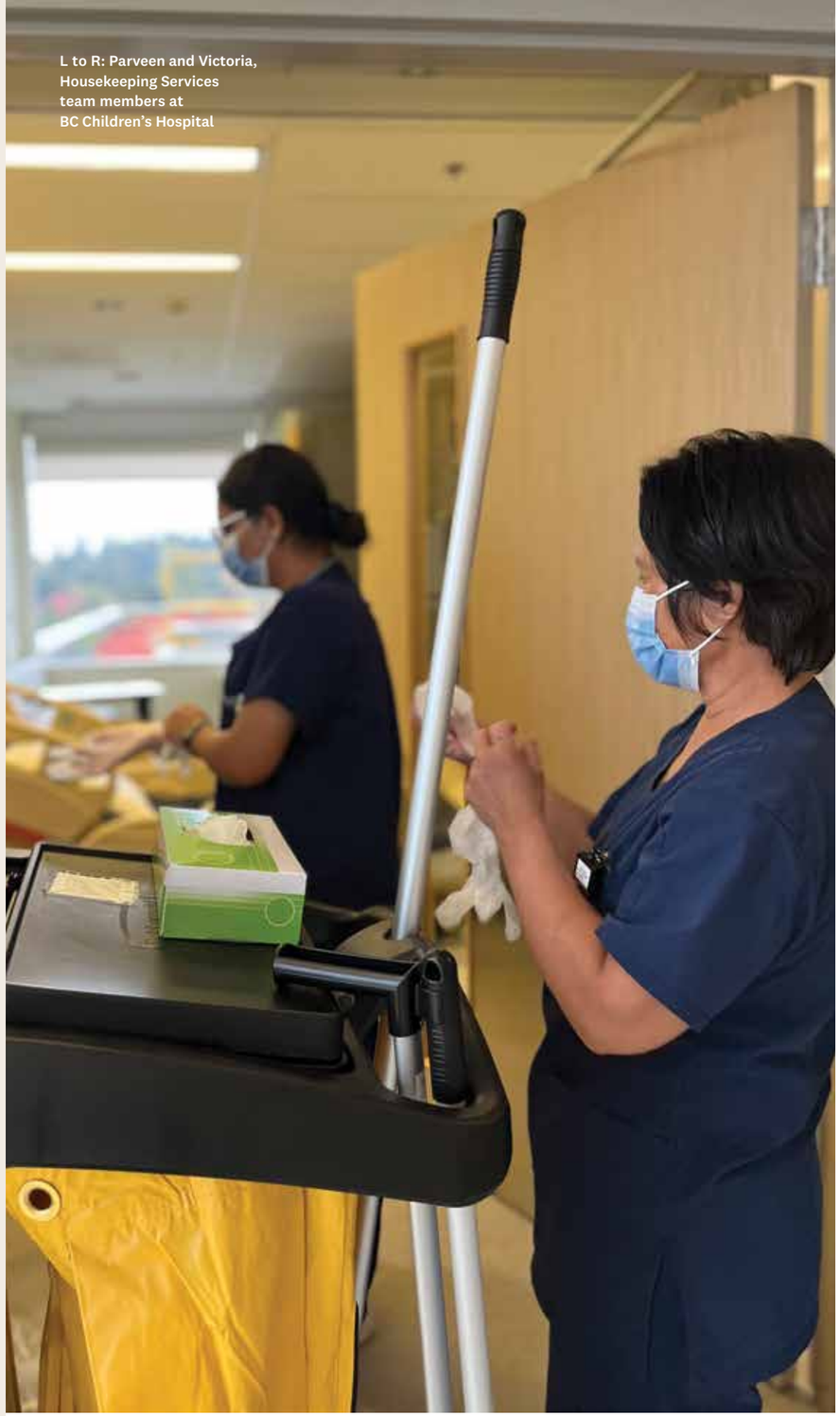
Mighty strides can start with one idea, one action or one opportunity. One way BC Children's Hospital is working towards the best health care imaginable for kids is by focusing on training the brightest minds of tomorrow. Through fellowships, BC Children's welcomes qualified health care professionals from across the globe to come train with its expert clinicians and researchers. This program has helped transfer knowledge and shape the future of children's health care—from Victoria, Canada to Nairobi, Kenya.

At BC Children's, clinical fellows undergo one to three years of additional subspecialty training in a specific area of care. They take part in intensive, hands-on training to gain the expertise and advanced skills they need to provide the highest level of care to children and their families. Fellows come from different areas of the world to learn at BC Children's Hospital, creating a legacy of care, learning and sharing for years to come both in Canada and globally.

Many fellowships are funded through BC Children's Hospital Foundation, supported by generous donors like you. Thank you for investing in the future of child health.

120+
CLINICAL AND SURGICAL FELLOWS AT BC CHILDREN'S HOSPITAL

HONING THEIR SKILLS ACROSS
20+
AREAS OF CARE



L to R: Parveen and Victoria, Housekeeping Services team members at BC Children's Hospital

MICRO MOMENT

6th Floor, Teck Acute Care Centre,
BC Children's Hospital
Oct 17, 2023, 8:00 AM

When children and families face the unimaginable, there's a powerful team standing behind them. And sometimes, it's the small social interactions that make the biggest difference.

Victoria and Parveen are two BC Children's Hospital staff members who work tirelessly behind the scenes as cleaners, contributing to the supportive experience of patients and families. As an employee of over 20 years, Victoria speaks about the countless moments of laughter, bravery and love she has witnessed within these halls. One of the highlights of working at BC Children's is the daily "hellos" and updates from patients who come to her during their time here.

"The kids always say 'hi' in the morning and when they're discharged, they're so excited to let me know they are going home. They always recognize me, especially the kids who stay here for a long time. They'll say 'mommy, look who's here.' I'm happy when I see them happy—when I feel like they have everything they need. I've seen a lot of emotions, but the parents and kids are very brave. That's what I've experienced through many years."

—Victoria

Never doubt what small can do. Big things come from small beginnings. Everything groundbreaking or world-changing starts this way.

The kids we help may seem small, but they face huge challenges. A sample of cells in a petri dish is small, but it could be the key to the next big breakthrough. You might think your impact is small, but your support could be just what we need to push the next medical advancement over the finish line.

Together, we'll show the world:

Small is MIGHTY.

MakeUsMighty.ca

BC Children's Hospital™ Foundation