

BLUE SKIES FACULTY FOLIO

INSPIRED





Childhood Motivation

Experiences in Sub-Saharan Africa spawned a career focused on alleviating trauma-caused death and disability

Back in the 1990s, a 10-year-old girl visited her cousin's house in Accra, the capital city of Ghana in West Africa. Somehow, the girl crashed through a window and badly lacerated her arm. In this time before cellphones her young cousin picked up the telephone and called multiple times for emergency care without a response while his cousin continued to bleed.

"I ultimately had to figure it out myself and get a taxi and get her to care," Nee-Kofi Mould-Millman recounted, years later. His cousin's experience with getting emergency care in a resource-challenged healthcare system matched his own.

"Being a typical rambunctious boy, I would not infrequently find myself in the emergency room with my own injuries," he says. "I would see people getting dragged in, looking lifeless, but not much getting done. It was very obvious to tell from an early age that something was wrong

with the emergency care system."

LOYAL FOCUS TO IMPROVE ACUTE CARE

That early awakening and a penchant for solving complex problems led Mould-Millman into medicine. He devoted himself to finding ways to improve acute care in Sub-Saharan Africa and other low-income areas and countries and continues that work as professor with the Department of Emergency Medicine at the University of Colorado School of Medicine.

Reflecting his worldwide healthcare perspective, Mould-Millman is also principal investigator for the department's C3 (Cape-Colorado-Combat) Global Trauma Network, which conducts varieties of research internationally in an effort to improve trauma care and patient outcomes, especially in areas with the greatest need.

His current research focuses on the Western Cape of South



Africa, where he has led studies of interventions to save patients with life-threatening bleeding as well as strategies for delivering timely care to trauma patients. Prior to that work, Mould-Millman worked to improve medical care capacity in Ghana, Kenya, Tanzania, and Zimbabwe.

“Ninety percent of the burden of trauma across the world happens in low- or middle-income settings,” Mould-Millman said. “So if your career goal is to help alleviate death and disability from trauma, then it is natural that you will be drawn to global health.”

His training didn’t point in that direction. With an undergraduate scholarship to Tufts University in Medford, Massachusetts, he began pre-med coursework. But those studies became a “side hustle” after he found greater interest in biomedical engineering and pursued his degree in the field.

Biomedical engineering appealed to his love of designing and building in the service of solving practical problems that directly benefited human health. It was the need he had seen in under-resourced healthcare facilities in Ghana.

“It was the area where I wanted to dedicate my life,” Mould-Millman said.

His commitment to biomedical engineering was so strong at that time that after graduating from Tufts in 2002, he took a “gap year” to move to Silicone Valley to “chase a career” in the field. Unfortunately, he arrived a year after the so-called dot.com bubble burst. Thousands of tech jobs vanished.

With the market depressed and employment opportunities scarce, Mould-Millman’s gap year became “a life lesson in practicality.” The only job he could find was a research job in medicine at Stanford – not what he wanted, but necessary to pay for his medical school applications and everyday survival.

He drew a career-defining lesson from the difficult year: engineering jobs may become scarce, but healthcare will always be in demand. He realized that a research team could gather data from patients, synthesize and analyze the information and from that draw conclusions that could improve health – a new route toward his problem-solving goal.

“I thought that was quite powerful,”

Mould-Millman said. The year that had started unpromisingly turned into one of his “first forays into public health and broad health applications.”

THE JOURNEY BEGINS

He left the West Coast for Northwestern University Feinberg School of Medicine to earn his medical degree. He originally aimed to become an orthopedic surgeon, which appealed to his engineering and mechanical sensibilities.

“Emergency medicine was not at the top of my list,” he confessed. But as he moved through his medical school rotations, he realized that a career repairing bones and joints didn’t mesh well with his commitment to return to Ghana to help fix the poorly resourced healthcare system he had experienced as a young man.

“A surgical skill set was very difficult to travel with,” he said. “One needed a lot of equipment and resources.” Working in Africa would require flexibility and ingenuity, he realized.

“You need to take what you have and twist it and make it work,” Mould-Millman said.

HE WANTED TO BECOME A VERSATILE PHYSICIAN WITH A WIDE RANGE OF KNOWLEDGE AND SKILLS. EMERGENCY MEDICINE CHECKED THOSE BOXES, HE SAID.

He then began his residency at Emory University in Atlanta.

“The body of knowledge and the breadth and depth of emergency medicine really appealed to me,” Mould-Millman said. “I realized

this was sorely missing in most of Sub-Saharan Africa.” Perhaps, he thought, a better-equipped healthcare system could prevent the avoidable deaths that marred his youthful memories.

“As a child and still today, hearing that a friend or loved one had a medical emergency and died needlessly is still a painful story,” Mould-Millman said. “Those moments really transformed the way I saw the world.”

WORLD-WIDE FOCUS

As a third-year resident, Mould-Millman put his commitment to global emergency medicine to the test. He sacrificed a month of his salary to return to Ghana to help support a new national ambulance service, train EMTs to improve trauma care, and write a portion of the law codifying it.

“It solidified my thought that I can take an emergency medicine skill set and travel to Sub-Saharan Africa to try and impact change,” he said.

After finishing his residency, Mould-Millman completed two fellowships at Emory. The first, in Emergency Medicine Services, built on his residency efforts to strengthen ambulance services in Ghana. The second, in Global Health, was vital to bolstering his knowledge of international healthcare.

“I KNEW THAT MY CAREER WAS GOING TO LAND AT THE INTERSECTION OF BOTH OF THOSE [FIELDS], WHICH IS EXACTLY WHAT HAPPENED.”

During the fellowships, Mould-Millman did a variety of project work, including evaluations of prehospital care and ambulance



services in Ghana. At their conclusions in 2013, he joined the University of Colorado Department of Emergency Medicine, where his career took yet another turn.

At the time he joined the faculty, Mould-Millman was in the midst of applying for a grant to study whether ambulance services could be used to save mothers suffering post-partum hemorrhaging. Recognizing he needed stronger research skills, he completed two nationally competitive emergency medicine research and career development awards (both between 2016 and 2020), then earned a Master of Science in Clinical Science from CU in 2021 and a PhD

in emergency care research from the University of Cape Town (South Africa) in 2022.

For Mould-Millman, the degrees are not ends, but a continuation of a life journey toward helping low- and middle-income countries around the world make the best use of the resources on hand.

“Discovering the interventions that are most effective in resource-constrained settings to avert and minimize mortality and morbidity in trauma patients is the goal and spirit of the C3 Global network,” he said. “That knowledge travels nicely [from South Africa] to Sub-Saharan Africa and across the world. Frankly, it even travels to the United States.” ■



BLUE SKIES FACULTY FOLIO

IMPACT

Triangle of Trauma

World-wide pursuit to improve trauma care

A triangle on a map that extends from Ghana in West Africa to Aurora, Colorado at the foot of the Rocky Mountains to Cape Town, South Africa, at the tip of the continent represents a span of tens of thousands of miles. But for Nee-Kofi Mould-Millman, the far-flung locations are united by a single word: trauma.

The word has been the focus of Mould-Millman's professional work and research for more than a decade and a presence for much of his life. Today he is the founder and principal investigator for the CU Department of Emergency Medicine's C3 (Cape-Colorado-Combat) Global Trauma Network, which participates in international research projects focused on improving trauma care in populations worldwide, including injured US military service members.

Mould-Millman's daily experiences as a young man planted the seeds that led to his current position.

Growing up in Accra, Ghana, he witnessed and experienced the damaging consequences of a healthcare system that was poorly prepared to treat the badly injured.

He left Ghana to pursue his post-secondary education in the United States, but always with the idea of returning to contribute to building a more effective system. Around 2011, during his third year of residency in Emergency Medicine at Emory University School of Medicine in Atlanta, Mould-Millman returned to Ghana to help train emergency medical technicians to staff the country's fledgling national ambulance service.

He pursued his commitment to improving emergency care for people in low-resourced countries with fellowship training at Emory in Emergency Medical Services and Global Health. After joining the Emergency Medicine faculty at the University of Colorado School of Medicine in 2013, Mould-Millman





broadened his expertise with additional training in research (he earned a Master of Science in Clinical Science from CU, and a PhD in emergency care research at the University of Cape Town in South Africa).

IT BEGINS IN AFRICA

Mould-Millman has centered his recent research on the Western Cape of South Africa, a province created 30 years ago that includes Cape Town. There is good reason for that, he noted.

“South Africa is the trauma epicenter of Africa and frankly of the world,” Mould-Millman said. “It has among the highest rates of mortality from trauma, and it is one of the most violent places, unfortunately.”

Mould-Millman said his fellowship work at Emory and as a junior faculty member at CU helped to fire his interest in addressing the problem of trauma in South Africa. During committee work with the advocacy group the African Federation for Emergency Medicine, he became close with two members from South Africa. They invited him to do some project work to bolster

the country’s trauma care and emergency medical services.

“That just drew me in more and more as I realized the magnitude of [South Africa’s trauma] problem,” Mould-Millman said. At the same time, he learned that South Africa has the longest-running specialty in emergency medicine and is viewed by countries across the continent as a healthcare leader and innovator.

In addition, the country’s large and diverse patient population and its mix of high- and low-functioning healthcare facilities made it a rich location for research that might be broadly applied, he said.

“[Providers in South Africa] are forced to think about what the most essential interventions are to sustain life and avert disability,” Mould-Millman said. That challenge made him think about healthcare inequalities he had seen throughout his life.

“THINGS YOU STUDY IN SOUTH AFRICA COULD BE RELEVANT TO AMERICA AND TO GHANA,” HE SAID. “SO I SAW THIS OPPORTUNITY TO STUDY TRAUMA IN A WAY THAT WOULD BE GENERALIZABLE TO MUCH OF THE WORLD.”

MILITARY INSIGHTS

Since 2018, the United States Department of Defense (DoD) has funded trauma research in South Africa by the C3 Global Trauma Network, Mould-Millman said. The focus areas have been dangerous bleeding, traumatic brain injuries, and complex wounds.

The initial DoD grant enabled Mould-Millman and colleagues to conduct interventional clinical trials

of a bundle of five EMS-delivered trauma interventions aimed at improving ambulance patients’ survival until they reached the hospital. The 2,000-provider system adopted the changes.

Encouraged by the success of that first study, the DoD invested further research in the Western Cape, starting with an epidemiologic study of trauma termed “EpiC” (the Epidemiology and Outcomes of Prolonged Trauma Care).

Mould-Millman noted that literature from the DoD, produced after studying injuries from bomb blasts and other violent attacks, demonstrates that for major trauma patients, mortality rises with every minute that passes. The U.S. military has already anticipated that timeliness of care will be a major issue in future battlefield planning, Mould-Millman added.

While insights from the DoD literature shows that “trauma is a disease of time,” Mould-Millman said, a large knowledge gap persists on the civilian side. “What about civilians who are shot or stabbed or have bad car wrecks? What is the effect of delays to care?” he asked. “In South Africa and many low-income settings around the world, that is just a daily reality. There isn’t quantitative data to help inform our thinking and decisions.”

CIVILIAN LESSONS

Lessons learned from civilian trauma care in South Africa could also prove valuable for U.S. soldiers, Mould-Millman said. Epic

EpiC aimed to help quantify the benefit of various life-saving interventions, and also describe how delays to trauma care impact

survival in a resource-constrained high-trauma setting. To answer those questions, C3 researchers are following 30,000 Western Cape patients enrolled in the EpiC study from the point of injury through a 12-site care network of hospitals, ambulance bases and mortuaries. Along the way, researchers capture all the interventions performed on patients – resuscitations, vital signs, and surgeries, for example – until they have a final outcome, he explained.

THE ANSWER IS IN THE DATA

With “millions of data points” gleaned from thousands of trauma cases, Mould-Millman believes providers will be able to draw conclusions about the most effective and timely treatments – and the best use of resources – for particular wounds and injuries.



“EPIC LAID AN IMPORTANT KNOWLEDGE FOUNDATION AND ALSO PAVED THE WAY FOR A MYRIAD OF DETAILED SUB-STUDIES INTENDED TO ANSWER MANY DIFFERENT GLOBALLY RELEVANT RESEARCH QUESTIONS,” MOULD-MILLMAN SAID

In one sub-study, for example, researchers looked at the effects of administering tranexamic acid (TXA) to critically injured and heavily bleeding patients. The relatively inexpensive drug blocks clots from breaking down to slow dangerous bleeding.

“It’s not used much in the U.S., except for postpartum hemorrhage and surgeries with heavy blood loss,” Mould-Millman said. “But it is widely used in [South Africa], especially in trauma.”

The sub-study showed that TXA administered to critically bleeding patients reduced mortality between 26% and 30% compared to comparably injured patients who did not receive it, Mould-Millman said.

“That’s a staggeringly high survival benefit from a drug like this,” Mould-Millman said. As a result, the Western Cape statewide emergency medical services system adopted TXA as a standard part of their procedures. The findings were later supported in a similar analysis of TXA used to treat U.S. military combat casualties with traumatic brain bleeds, a report Mould-Millman and colleagues published in 2023.

The C3 Network has also conducted studies of debated trauma care issues, such as use of freeze-dried plasma to treat life-threatening injuries and the effects

of delays to emergency surgical care. The common thread is a bid to find strategies to save critically injured persons in resource-limited settings, especially those who have incurred long delays prior to final care.

In general, providers in the United States and other high-income countries don’t have to think about using scarce medical resources as judiciously as possible, Mould-Millman concluded. But for much of the rest of the world that is often a life-and-death consideration.

“That is the world that military providers and providers in low-income settings have to deal with every day,” he said. “That is the space I function in and that is the mission of the C3 lab, to discover those interventions that are most efficacious in resource-constrained settings.” ■