



*Kevin Tyan, Jason Kang and Katherine Jin, inventors of highlight and winners of the USAID's competition, Fighting Ebola: A Grand Challenge for Development. Photo: Courtesy Kevin Tyan*

## **Fighting Ebola from an undergraduate laboratory: a group of friends on their journey to tackle the crisis**

It's 5pm on a cold November night, and Columbia University's Seeley W. Mudd engineering building, or simply 'Mudd,' as it's known on campus, is packed with students beavering away on their laptops, as mid-term exams are fast approaching.

The biomedical engineering undergraduate laboratory in the basement is full of students in lab coats who pore over their equipment, carefully analyzing their findings. Sitting in a room next to the crowded lab, 22-year old Jason Kang reads his laptop screen carefully, wearing a casual t-shirt and jeans.

Kang is a senior at Columbia's School of Engineering and Applied Sciences, majoring in biomedical engineering. He and fellow Columbia students Katherine Jin, 22, and Kevin Tyan, 21, are working on a startup, Kinno; they've developed a product that may change how health care professionals deal with containing infectious diseases like Ebola.

Their product, *highlight*, is a powdered additive that colors a disinfectant blue, enabling healthcare workers to see what areas have been sprayed. It also prevents evaporation and extends contact time of the disinfectant to the surface. The product, currently manufactured in small batches by the trio in Columbia University labs, doesn't require any special training to be used. "Powders are light weight, have a lot longer shelf life and are portable and robust" said Kang. After 10 minutes, the color fades, indicating to the user that the surface has been decontaminated while also preventing staining of reusable clothes.

"We've all been good friends since freshman year," says Kang, who with Tyan belongs to the Lambda Phi Epsilon fraternity, which claims to be the world's largest Asian fraternity. Jin met Kang and Tyan during freshman year also, when she began at Columbia University as a Coca-Cola Scholar; the scholarship that awards exceptionally bright high school seniors with \$20,000 for college tuition expenses.

The three friends started working on *highlight* in October, 2014 – at the height of the Ebola crisis in West Africa. At the time, Columbia had started an Ebola Design Challenge to encourage

students and faculty to come up with rapid-fire solutions for the problems health care workers were facing on the ground. “Jason’s original idea was to treat Personal Protective Equipment (PPE) suits so that they faded upon contact with bleach,” said Tyan. “I had the idea to bring the colorant to the bleach itself to simplify the process.”

The Ebola Design Challenge fell on Kang’s 21<sup>st</sup> birthday. “I almost didn’t go, but Katherine said ‘You have to go!’” recalls Kang. The three of them spent many late nights and weekends coming up with a formula that would thicken the product and get it to the right consistency to slow down how quickly the disinfectant evaporates. To ensure that the product worked in hot African countries, the team tested it under the sun to make sure it would work under any circumstance.

After the team showcased their product at the Design Challenge, the judges, including healthcare workers and professors, said that they liked the simplicity of the product. Reflecting on the challenge, Dr. Christopher Aston, director of the Biological Safety Program at Columbia University and one of the judges of the challenge, sits in his brightly lit office with, with pristine white lab coats enveloped in plastic coverings hanging from the drawers beside him. “I actually think it was the best idea out of all the ones presented. The thing we were looking for was something tangible and pragmatic to implement in short notice in West Africa,” said Aston. The team received \$150 to make a prototype and after a week, they demonstrated the revised product. Eventually, the trio became finalists and received \$500 more.

With the 2013-2015 Ebola outbreak reaching an end, with only Guinea still seeing new cases, the team is looking for other applications for their product.

They spoke to Dr. Ian Lipkin, director of Columbia University's Center of Infection and Immunity and one of the judges of the challenge, who offered to help test their product on other infectious diseases. "He's a superstar in the field of infectious disease," said Kang of Lipkin.

After the trio were featured in an article in the New Yorker, the chief medical officer of the Fire Department of the City of New York (FDNY), Dr. Kerry Gelly, reached out to Dr. Lipkin and invited the team to Ebola training sessions with FDNY at Staten Island University Hospital and Mount Sinai University Hospital. FDNY bought some of the product from the team and incorporated it into their Hazardous Materials program for December, 2014. "That was the turning point, from a project to a product" said Kang.

The team applied to the United States Agency for International Development's (USAID) Fighting Ebola challenge. After they were notified that they were winners in February, 2015, they won a substantial sum of money to further develop their product. While Kang didn't disclose the actual amount, he said it was "Over half a million dollars." The team used the money to test their product under different environmental conditions.

While their product seems applicable in circumstances other than the Ebola crisis, Dr. Portnoy, an advisory board member of Doctors Without Borders, is not sure it is because of Ebola's very specific transmission through all bodily fluids. "I don't see it having applications for cholera or

malaria,” which are transmitted through the fecal-oral route and by the bite of a female *Anopheles* mosquito carrying malaria, respectively. Portnoy does however see the benefits of its use as an Ebola infection control product, saying “as a healthcare worker, if you’re kneeling in vomit or blood, you could spray that area immediately afterwards.” He also suggests that using *highlight* would be helpful when health care workers are sprayed with decontaminants before removing their protective suits, particularly for outreach and burial teams. Outreach teams, who do follow ups with patients that have been discharged and who remove sick patients from their homes and escort them to hospitals, could use the product to decontaminate a home. “If you’re spraying the whole house and it doesn’t stain the house, then you know the coverage and how well it was sprayed,” said Portnoy.

The team traveled to Liberia in November, 2015 with Concern International, an NGO that has an Ebola treatment unit in Liberia. “Feedback was overwhelmingly positive, and most people were interested in how quickly we could come back with more *highlight*,” said Tyan.

They conducted questionnaires and compared standard bleach to bleach mixed with *highlight*. “We’re making minor adjustments based on feedback, but we hope to go back there and have it used by people,” said Kang. The trio ended their trip by meeting with two infection prevention consultants from the UN’s World Health Organization (WHO) who seemed interested. However, to get *highlight* into Liberia, it has to go through the ministry of health.

The WHO representatives advised the trio to package *highlight* with the disinfectant, however, the Liberian government only purchases one type of bleach from one company in Liberia, and the trio is currently in the process of contacting the bleach company.

If an Ebola emergency were to break out again and healthcare workers were to use *highlight*, they'd have to bear in mind that one small bottle contains around 100 grams, and that goes into one gallon of disinfectant, with one bottle of the powder costing less than one dollar to produce. "It would cost about 4 cents to disinfect one suit," said Kang.

While the trio continues to manufacture and label the product themselves, they hope to scale up and outsource production in a few months' time. For now, though, mid-term exams call and the three are working hard towards those.

With all three students in their senior year, they've discussed their future plans for their product after graduation. They have agreed to continue working on *highlight* for at least a year after graduation, committing fully to the company they founded together, KinnoS. They have a lot of momentum and admit that they've gone a lot further than they thought. "It would almost be a shame to stop now," says Kang.

Kang unscrews a small plastic container of the product. It's a blue crystal-like powder resembling the type of sugar you'd use to decorate cakes or cookies. "Just don't smell it!" Kang says, laughing. He adds "It should be fine, but you don't want to risk it. With any fine powder, if you inhale it, it can go into your lungs, so it's just better not to smell it." Kang saunters back to his laptop, ready for another late night of hard work.

By *Cécile Borkhataria*