GREEK-born molecular microbiologist Dr Makrina Totsika likes nothing better than busting stereotypes. It’s one of the best things about inviting high school students into her laboratory at the Queensland University of Technology’s Institute of Health Biomedical Innovation.

“They come in and they still expect the professors to be men with bald heads,” Dr Totsika tells the MJA.

“For that stereotype to still be around is amazing to me. Why are kids still expecting that? Yes, there is still gender inequality in academia but I like to be able to show them that you can be a young woman and doing science.”

Recently Dr Totsika was named the co-winner of the Queensland Young Tall Poppy of the Year award for her research into finding ways of “disarming” rather than killing multidrug resistant superbugs.

She shudders a little at the term “superbug”.

“It has bad connotations,” she says. “Yes, we need to be telling people about the problem of drug-resistant bacteria but we shouldn’t just do it with fear. We also need to tell people about the weird and wonderful things bacteria do.”

“Doing science” has been Dr Totsika’s passion since high school, back in Greece.

“I was always interested in genetics,” she says. “But I didn’t get into the university I wanted so I ended up at the University of Edinburgh, of all places!

“I thought I was proficient in English — I had a proficiency certificate from the University of Cambridge — but I didn’t expect to arrive in Edinburgh and not understand a word people were saying.

“But it was brilliant being there. I’ve never looked back.”

While doing her undergraduate work in biological science and genetics she was offered a 4-year PhD scholarship from the Wellcome Trust, the first year of which was spent rotating through various disciplines.

“My first rotation was in stem cell research which was what I had been most interested in, but I found that I didn’t really enjoy it — the interactions … it didn’t really fit for me. But then I did a rotation on bacterial genetics and suddenly everything fell into place.

“I realised, oh well, I guess I’m in infectious diseases now!”

In the end Dr Totsika spent a decade in Edinburgh until “the weather started to get to me”, and while she was in Australia for a conference in 2007, she began scouting around for a job. Connections were made, like interests were matched up and the rest is history.

Dr Totsika’s work revolves around Escherichia coli and her passion for the bug and its abilities knows no bounds.

“Poor E. coli,” she says. “They are the good guys who turn into the bad guys. They started out as part of the normal gut flora … they were commensal. Not doing any harm. And now they are at the top of the World Health Organization’s list of pathogens of concern.

“They get out of their environment and into, say, the bladder, and cause urinary tract infections, for example.

“E. coli was a bug that nobody thought would become a superbug and now it’s picking up drug resistance all the time.”

E. coli, it turns out, are smart and adaptable.

“They have so many behaviours,” Dr Totsika says. “Everyone says they’re one step ahead of us. Actually, they’re 100 steps ahead of us, and that’s why it is so important that we have ongoing research going alongside.”

Most important to present-day research is the use of “clinically relevant samples” of the bacteria, she says.
Dr Totsika’s excitement is palpable, and it’s that sense of wonder that makes communicating with high school students and young scientists such a pleasure for her. “In some ways I still feel like an outsider,” she tells the MJA. “I’m still amazed by how bacteria do these things, and that’s why I enjoy talking to the students so much. I like being able to inspire people about science. “Raising awareness is important but we must deliver it in a way that people can absorb. Give them what is exciting and important and let them be the judge of whether they need to know more of the details.

“I have spent a lot of time with E. coli trying to understand what their weapons — their virulence factors — are,” she says. “These adhesins have a little ‘hand’ at the end of them, which recognises the ‘handle’ on the host cell and clings on. The more force you put against them, the more they hold on. “I’m fascinated by trying to work on how it’s turned on and off, how it is used during infection.”

Even more intriguing is that different strains of E. coli turn their “stickiness” on and off in different ways. And each strain can have 15 to 17 different types of adhesins.

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“These bugs are definitely multidrug resistant, so we can’t kill them. So what can we do? I’ve been flirting with the concept of disarming them rather than killing them,” Dr Totsika says. “If we can stop them adhering to the host cells, then we can make a difference in how or if infection develops.”

In a study recently published in the Journal of Infectious Diseases, Dr Totsika and her US collaborators demonstrated that oral inhibitors of a bacterial adhesin could be used to successfully prevent and treat multidrug resistant urinary tract infection in preclinical animal models.¹

Through two ongoing National Health and Medical Research Council (NHMRC) project grants involving collaboration with leading experts in Australia and the US, Dr Totsika’s research is expected to lead to next-generation antimicrobials that will be tailored to each patient’s infection.

In addition, there’s the possibility of the treatment being used as a prophylactic for people with a history of recurrent infections caused by E. coli.

¹. http://jid.oxfordjournals.org/content/208/6/921.full?sid=8d258a5c-c0f3-4a3c-9ac4-6b054a54f8d6

Cate Swannell
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Dr Linda Iles has to plan for the unthinkable — a mass casualty event on Australian soil, whether man-made or natural. It’s something most of us don’t ever want to contemplate, but for Dr Iles and her colleagues at the Victorian Institute of Forensic Medicine (VIFM), having plans in place for the worst-case scenario comes with the territory.

“We put a lot of work into contingency plans and exercises,” Dr Iles, who is Head of Forensic Pathology Services at the VIFM, tells the MJA.

“It could be 20 people, 200 or 20 000. We can only hope that it doesn’t happen here, but if it does, we need to know how to deal with those kinds of numbers.”

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Dr Iles and her team have been instrumental in several large-scale victim identification events in the past — the Bali bombings, the Boxing Day tsunami, the Christchurch earthquake, the MH17 air crash in the Ukraine, and, on home territory, the Victorian bushfires.

The Boxing Day tsunami in 2004 killed at least 226 000 people across 14 countries, including 166 000 in Indonesia, mostly in Aceh Province!

Dr Iles was in Thailand after the tsunami, as part of a team of pathologists, dentists, police, and others which identified around 8000 victims, bringing closure to their families.

“It’s hard to comprehend the numbers,” she says now. “But when you look at Aceh, those numbers are ... you can’t comprehend them.

“Even though we have been involved in circumstances that are horrible, it’s always gratifying to help the families and loved ones. In fact, it’s a real privilege to be involved. It’s very rewarding. The important moment came when we decided to work at identifying everybody, regardless of their nationality.”

Dr Iles graduated from the University of Tasmania in 1997 and had the chance to be an anatomical pathology registrar at the Royal Hobart Hospital after completing her internship.

“Back then you couldn’t complete your anatomical pathology training all in one centre, but there were no other centres in Tasmania so I came to the Royal Melbourne Hospital to finish,” she says.

Hobart, it turns out, is an excellent nursery for pathologists, both anatomical and forensic.

Cases that involve children are the most affecting, she says, but increasingly, the excessive violence associated with methamphetamine use are the cases that can be the most confronting.

“We’re recognising [methamphetamine cases] more, whether that’s because of increased numbers, it’s hard to know.

“But the victims of violence inflicted on them by [methamphetamine users] is over the top. The totality and extent of the injuries is very confronting.”

Seeing what they see and doing what they do on a daily basis, there is a risk of burnout and post-traumatic stress disorder (PTSD) among forensic pathologists, Dr Iles says.

“There certainly is a potential burnout factor. Here at the VIFM our staff take a sabbatical every 6 years. It’s really important to get re-energised. It’s great to see them coming back recharged and with new ideas.

As for PTSD, the VIFM has put together a working party to look at evidence-based approaches how the concept of “vicarious trauma” affects the staff. “We’re looking for the best way to see if our people are alright, and how we can support them,” Dr Iles says.

For Dr Iles what is important is balance in her life. She spends her off-hours with her partner and their pets, swimming and cycling — vital antidotes to the stressful and confronting realities of her “day job”.

“A happy, balanced home … that’s the most important thing,” she says.


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