Podcast episode ‘Hidden Companions: How Parasites are Adapting to a Changing World

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The world is changing from the climate crisis to AI to the cost of living. It has affected all of our lives in different ways, and is not just us humans that are impacted. Parasites are emerging in new areas and populations it hasn't been seen in before. They can range from relatively harmless ones like tape worms, to those that are devastatingly fatal, like malaria. For example, in the US, there are about 2000 cases of malaria yearly, mostly from foreign travel. In 2023 however, it was reported that there were 10 cases of malaria that were locally acquired. So although for now, cases are rare, are healthcare professionals prepared if those numbers of new parasites begin to rise in this month's microbe talk, I will be chatting to an expert in the field, King of kovalevska grohovska, a professor at the University of Alberta in Canada, to find out more about our relationship with parasites, the problems with current diagnostics and how AI could potentially help in the future. I Good morning and good afternoon. Welcome to microbe talk. Let's start off by introducing ourselves. Hi.

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So my name is Kinga kovaleska grovska, and I know it sounds like a like a mouthful. That's because it is. I'm basically a university professor, University of Alberta, Edmonton, Alberta, Canada, but I also work at the provincial lab for public health. So I combined research through my university, but my research is a little bit more applied because of the nature of my work. This is something that has to be clinically relevant for human health or public health, also, because I deal with reference parasitology, This often includes unusual parasites and unusual life situations.

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Yeah, and that's the kind of theme of the paper that you've recently published with us in microbial genomics. And the reason why I invited you on today to talk about the world of parasitology and how it's changing with the rest of the world. And I want to start really basic for anyone that might not know what a parasite is. Could you explain briefly what it is? Is it a specific type of organism or more of a way of life?

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So the parasites are creatures that are in constant relationship with human they live inside us and on top of our bodies. They're more complex than bacteria, but they do have a very special relationship with us. If you consider your body a home, then a parasite would be an unwanted tenant, because it inhabits our bodies and and basically uses all the amenities of the body and provides very little in return. So this parasitic lifestyle, by definition, is of benefit mostly to the parasites and have very little benefit, if any, to the host. However, that relationship does not have to be adversary, because the most successful parasites are the ones that actually do very little harm to the host and and so can continue living in sort of an easy harmony with the host, but, but always, always retain that potential to harm a host.

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That's a great analogy that you use there of the tenant and the host and what might be some kind of famous parasites that we might all know of.

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Well, I think the best known parasite to everybody that readers can sorry, the listeners can relate to our pinworms. And think in fact, every one of us would be able to ask a question of your Mother, did I ever come back from school with an itchy bum and that the mom said, Oh yes, ping. Worms are parasites that actually live in our gut, but they come out at times to lay eggs around the perianal skin, and that, of course, makes your bum itchy. They're very popular and very commonly found in childhood. So I think that's the the one that is best known.

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And in your paper, you mentioned that we have evidence of this going back quite a long time. Would you be able to tell us more about you know that those first evidences that we have at the moment,

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per se? Were identified in coprolites. And coprolites are fossilized human store, but they were also seen in in many other human remains that are 1000s of years old. Some of these parasites, such as tri curious or even round worms, were were seen in coprolites recovered from the ancient Egypt and from the Iron Age. So these are one of the earliest parasites that we actually have seen and have evidence of presence of in in human history. That is something that something tangible that we can actually dig out and and show to prove their coexistence with humans.

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I think it's so fascinating that we can actually see that really highlights this relationship. And you speak of this relationship changing with the advent of the microscope. What did scientists start finding out around that time.

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This is interesting, because although we were carrying parasites around, we were not really fully aware of their existence. As I say, most successful parasites don't actually create too many symptoms. First time we could take a good look at and first time that humanity could actually see and scientifically describe parasite was actually when microscope was invented. And that's another really interesting story, because although the Janssen, or Janssen father and son duo invented microscope in the 16th century, the microscope only became useful with Anton van Lovell look, who was a Dutch cloth merchant in the 17th century, and who actually came to London and first encountered the first microscope, and that first microscope was used for him to inspect the quality of the cloth that he was buying and selling. Well, Anton was a very great entrepreneur, so he thought, oh, you know, I'm going to bring it with me and see if I can put it to other use. And this is when he started using it to observe small creatures, and this was in the days where where people thought that the disease is is caused by bad vapors. So it revolutionized the way that we look at infections and infectious diseases. That's why I mentioned that this kick started the microbiology as we know it, including parasitology, because that was the first tangible proof that that you can see something beyond what the human eye is able to grasp. Amazing.

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And can you explain for us what kind of tests are being used today to diagnose a parasite, like, what would a person encounter if they went to a hospital thinking they had a parasite? For example,

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early parasitology, until recently, basically involved looking at human samples, mostly store as stained preparations that could be a value evaluated by microscopy. This served our purpose for a long time, but then we realized that some of the parasitic infection are not necessarily in the gut, and because they're located in other places on of the body where they're not easily accessible. To collect specimen specimens from, we had to turn to other means of diagnosing cases where the specimens were not available. And it was, as I always call it, the meteoric rise of molecular biology and its entry into diagnostics. This was the this was what I like to call diagnostic revolution, because that that changed parasitology landscape forever, because then the molecular approaches could detect not only parasites, but also viruses, bacterial and fungi and as well as parasitic pathogens. And they were and people even went one step beyond. They were focusing on a clinical syndrome, which could be, for example, diarrhea, if you are admitted with gastrointestinal upset, then why look just for parasites, when you can use this multiplex PCR to look for anything that could possibly go wrong, and would look for agents of. Intestinal disease that were parasitic or viral or bacterial, so that could also be made, could be also automated. You no longer needed a person that took years to develop expertise to sit there and examine the whole specimen, you could actually collect the specimen, put it into an automated, automated system, and have an answer within 15 minutes. So that actually took the parasitic world by the storm, fantastic.

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So from microscopes to now, detection and diagnosis has undergone this huge evolution with lots of improvements to technologies. But then again, there are still issues with the current diagnostic test, and there may be a need for further

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advancements now. Right

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now, even if you look at it from parasitic point of view, there's hundreds of parasites that humans can harbor, so you have to take your pick in order to make it financially viable. And so what we did as a group of scientists, we selected the most common parasites to become a part of the panel, and particularly with the syndromic approach, when you use a specific panel in a specific clinical situation, such as gastrointestinal upsets, such as diarrhea, we usually select four or five commonest ones. And yes, this creates a situation where large, high volume laboratory can handle hundreds of specimens per month, because all you do is you take the patient's specimen and and take an aliquot and and process it through the automated system in the machine that uses molecular techniques to detect the presence of those key parasites, such as, for example, amoeba or Cryptosporidium, to name the most common ones. But this creates its own problems, right?

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So the faster methods are only screening for a select few parasites which are the most common, but some of the problem is that the common parasites are changing and are not reflected in the diagnostic tests used at the moment. So can you tell us more about what's causing this change?

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So I think what the important part point I was making in my paper is that before we jump into solutions, we're still at the wrong point of our development. Now, even if we look at molecular diagnostics as the ultimate tool, because we don't have enough experienced people, because counting on human experience and to the time that is that is needed to make a proper diagnosis. That diagnosis is money, and everybody is very short on budget. The old fashioned solutions that don't work produce the solution that still doesn't work, but in a different way, using those those multiplex PCRs, which are the molecular tools that select commonest causes of certain clinical symptoms. What we don't realize is that this is what worked five years ago, maybe 10 years ago. All these panels are geared towards a certain specific population that we We rightfully considered a target in those days. But the point of my paper was that this is no longer correct. The people that are now making mosaic of our societies, both in Europe and in North America, are different. They bring parasites with them and diseases that that the panels that are currently including do not cover, and also because of climate change, the parasites that we see now are different. Parasites that we did see even 10 years ago. Extreme weather events and issues like that are changing the composition of parasites locally and and our our own action are changing the composition of the society that we serve.

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That's really interesting. So can you go into more detail about this environmental factor?

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Well, yes, what happens is, whenever climate changes, it influences the parasites environment that they live in, in the niches the parasite habitats are changing. This is climate change as such, but also human action such as deforestation, where we physically change our environment. So another example. Example is ticks. They as the world warms up, the tick territory is expanding northwards. We are seeing in Canada ticks that we've never seen before, and this is due to directly to climate change. I'll give you one last example, because it's really interesting, and that's the other area of my special research. There is an organism called a kinococcus multilocularis, which is a tapeworm that, in humans, present as tumor, like liver lesion. And it's, it's actually, if you don't catch it in time and and don't treat it. This particular tapeworm, a larva that grows in your liver, is 100% lethal, so mortality at about 1015 years, is almost 100% now this has not been known in North America, but since 2012 we have noticed the first case. We have actually picked up first case in Edmonton, and since then, we have 42 cases in only one province of Alberta, which is where I work. Obviously this must have first been imported by human action, by importation of of infected animals. It usually can you can catch it from from your pet dog, but then it spilled onto local wildlife, local canids, and contaminating the eggs of that parasite started contaminating the areas around the towns, and now it's becoming a huge problem, of which nobody had heard of in human patients before 2012 so this is clear connection with our actions that add the effects to what is already happening through climate change and migration of species. So that's two examples.

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So there's this increasing risk of new parasites that you see in example for where you are in Canada and other countries around the world. So in your point of view, what are the steps that are needed to be taken at the moment,

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the number one step is to realize we have a problem and spread awareness of the fact that we are in great need of a change. I think this is already happening because people are aware of of climate change, even though there's still a lot of non believers out there, and we as healthcare professionals should, should address all the needs of the immigrants, because of the benefits that immigration brings to this country. I'm actually one of the immigrants. And you know, there wouldn't be research on a kind of caucus multilocularis, which is that tapeworm that I was talking about, if I wasn't here. Well, that's probably somebody else would pick it up, however. So, so the first step is increasing awareness. Second step is making sure that that this awareness extends beyond the people that raise the alarm bell. So success very much depends on availability of the tests, and companies willingness to start producing tests that are that extend the coverage to unusual, previously unusual, but now mainstream parasites, because this is our reality that we live In. Now, there's one step that I didn't talk about, and this is AI. So there are at least two companies that are already there and have developed parasitology programs that can be hooked up to a microscope. So basically, the way it works is you employ the microscope and a scatter that scans and analyzes a microscopic field. This information is then analyzed by the software using all the necessary artificial intelligence machine learning algorithms, and this results in diagnosis of that, we see these particular elements that represent these particular parasites. We're really at the early stage yet, because after rigorous clinical trial, this can be released to be used in clinical practice in the laboratories and the two companies that I've mentioned before have actually gone past these clinical trials, particularly one that is taking the US by the storm. Still there is criticism, still there is uneasiness that we all have with this. Right?

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Right? And why is there this feeling of unease? Do you think

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I myself, don't believe that we're at the stage yet where we could leave everything delegated to the computers, but I do believe we can gradually implement this, but at least having the artificial intelligence, screen off and reject the negative slide and decrease the workload for human intelligence.

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Having said that

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there is, there is a possibility for bias, because, by definition, artificial intelligence learns from its own experiences. So if you leave it alone and don't observe it, don't supervise it at all times, it can bias itself towards the wrong conclusions. So it's a responsibility, right?

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So there is still this responsibility, as you say, for humans that are trained to be able to make those decisions, what are the things that you'd like to see in parasitology to deal with the reducing workforce?

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So the memory bank, which is what I like to call it, is depleting as we speak, and with every year that we stall, or say that our problems are going to be magically resolved because AI is coming. Every year, there's more and more parasitologists leaving the workforce, and more and and less and less people left to actually upgrade, to actually produce new AI algorithms to update existing AI algorithms. So it's a catch 22 situation. So I think we have to realize that it is important to maintain expertise to at least do some really reasonable succession planning and make sure that each and every place that deals with patient specimen has some plan for for maintaining that expertise before it is too late, because we're not quite there with AI yet, but we already not there with human expertise that is basis for successful AI

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integration into our sciences, right?

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And I think that is a kind of common point of view that we need to proceed with caution in terms of AI we've talked about all of this doom and gloom and things that need to improve, but I'd love to know what are the things that you love about parasitology, or get you excited about working in parasitology that you'd like to share, maybe for someone who's deciding whether to go into it as their career.

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Well, you know, I'm biased, because I do love parasitology. In all honesty, parasitology is the most beautiful of specialties, because what I always say is parasites are very much like people. They have the same lifestyles as people, and that's mostly what, what drew me to parasitology. If you look at parasites life stories, they're very much the same when, when they are the younger stages in life. Well, the youngest stages in parasite life, like embryos inside parasite eggs, let's say, for example, are very much like human babies. They cannot do much. They need to be taken care of by the patients. Then, as larvae hatch out of the eggs, just like human adolescents and young adults, they go traveling. They don't settle in one place. So humans go and take a year off after university, they go to see the world. Parasites, larvae usually migrate through entire body, looking for a place to settle and and then they become adults. So just like humans that settle down, you know, buy a house, white picket fence, and start raising the family, the adult parasites decide what's the final location is in human body, whether it's a gut or, you know, let's say the liver, bile duct. They settle down there, they find their parasite mate, and they start producing baby parasites, and basically, the cycle closes again. So it's this analogy between parasites and humans. That drew me to parasitology. You practically have to put your mind into, what would I do if I was a parasite? And then you know what's going to happen next. You never have to do memorization in parasitology. You just think, what would parasite do?

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I love that. Is such a great analogy again, and a slightly happier note to end on. So just like to say, thank you for your time. You're welcome. You're welcome. You've been listening to microbe talk, the podcast by the microbiology society. If you enjoyed this episode, give us a like, follow us on social media or leave us a review, to share your thoughts with us. That's all for this episode. See you next time.