People worry about many things, but generally not the right things. We tend to spend more time thinking and worrying about risks that are dramatic and scary, or that have been made popular in the media, but unlikely. We fret more over shark attacks, terrorists, our children being abducted, or crashing in a commercial jet when these are all very unlikely occurrences.

Beyond individual harm, people also worry about the collapse of civilization – the coming apocalypse. These threats are mostly real (zombies and rapture aside), just like the ones above, but we should be clear about the relative risk. We will one day be hit by a large asteroid, but probably not anytime soon. We should keep an eye on the bird flu, but I wouldn't panic just yet. It seems reasonable to take prudent measures to mitigate global climate change. There are also some problems that I think we will likely deal with in due course, like "peak oil." And some threats never materialize – remember the "killer bees?"

Press coverage and public awareness of such threats, however, is not proportional to their risk. One looming threat is frequently overlooked, but a recent warning by Dame Sally Davies*, the Chief Medical Officer of the UK, is giving it some media attention – the rise of antibiotic resistance .

For the last century we have been engaged in an arms race with disease-causing bacteria. For the most part, the bacteria have been winning. We have developed a number of pharmacological weapons, antibiotics, to fight bacterial infections, and they generally work very well. They either stop bacteria from multiplying (bacteriostatic) or kill them directly (bacteriocidal), giving our immune systems time to gear up and wipe out the infection.

The bacteria, in turn, have been evolving resistance to our antibiotics. Worse – they are sharing their resistance with each other. Bacteria can share genes through transposons (self-contained transposable elements), including genes that confer resistance to specific antibiotics. Transposons may, in fact, contain genes for multiple types of antibiotic resistance.

Taking antibiotics confers selective pressure on bacteria so that the ones with resistance will preferentially survive. This is why it is important not to stop a course of antibiotics prematurely – the resistant bacteria will live and reproduce, perhaps developing multiple resistance. If you complete the course, however, then your immune system will have a chance to wipe out the infection, including the resistant bacteria.

Already the practice of medicine, especially in-patient, has been changed by the growing prevalence of resistant strains. Now as I roam around the hospital seeing consults, for example, I have to don a fresh gown and gloves to prevent contamination for an increasing percentage of patients who are carrying resistant bacteria. Patients with resistant infections are an increasing problem, and in some cases we are down to a single last line of antibiotic defense.

Doctor Professor Dame (the British love their titles) Davies further warns that:

"There is a broken market model for making new antibiotics, so it's an empty pipeline, so as they become resistant, these bugs, which they would naturally but we're breeding them in because of the way antibiotics are used, there will not be new antibiotics to come."

Essentially we are not developing new antibiotics quickly enough to compensate for the growing resistance to current antibiotics. The worst-case scenario is that we will enter a post-antibiotic era, where most bacterial infections are resistant to available antibiotics. Infections that were previously dealt with routinely could become fatal complications.

This is a problem that deserves to be taken seriously, because the potential harm to human lifespan and quality of life is huge, and also there are plenty of things we can do about it.

The first is to use existing antibiotics rationally. Most of this is the job of physicians – not prescribing antibiotics when not necessary, using narrow spectrum antibiotics when possible, and generally following proper guidelines. Patients, however, should not push for antibiotics when they are not recommended. Further – if you are prescribed an antibiotic course, finish it. Don’t stop when you start to feel better.

Industrial use of antibiotics also needs to be reviewed. Anyplace that antibiotic use can be decreased or replaced would be helpful.

It also seems that we need to increase research into developing new antibiotics or entirely new strategies for dealing with bacterial infections. The pipeline that Dr. Davies talks about needs to be filled.

I do think we will eventually solve this problem through incremental technological advances. This is one we can solve. If, for example, we develop sufficient types of antibiotics, we could cycle through them over the decades. When one drug develops a lot of resistance we can stop using it. Over time, without the selective pressure, bacteria will tend to lose resistance. Eventually we may be able to resume use of that antibiotic.

We may also develop non-pharmacological treatments, either immune system-based or perhaps through some type of nanotechnology. Who knows – in 50 year we may be zapping bacteria with some high tech gadget that is not amenable to resistance (resistance is futile). We may genetically engineer friendly bacteria to fight off disease-causing bacteria for us.

These types of long-term technological advances are all-but impossible to predict, but it does seem likely that we will develop some new approaches that don't suffer from the problem of resistance.

In the meantime, there are plenty of steps we can take (and are taking) as listed above. Hopefully in 50 years or so people will look back and if they remember the coming antibiotic resistance apocalypse at all they will think that it was all hype because it never manifested. However, that will be because we took specific steps and made a targeted effort to prevent it.

**I just wanted to point out that the same Dame Sally Davies also recently made headlines in the UK for calling homeopathy "rubbish" and homeopaths "peddlers." Good for her.*

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