

Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by arno - 03 Dec 2012 01:08

Antibiotic-resistant enterobacteria are being spread in sewage systems in India. NDM-1 producing bacteria were found in water supply and sewage seepage samples in New Delhi in a study from May 2011 in The Lancet (attached).

NDM-1 stands for New Delhi metallo-beta-lactamase. This is an enzyme that has recently been discovered in enterobacteria (such as E-coli, Klebsiella, Shigella, Proteus, Enterobacter, etc. These are mainly gram-negative bacteria which means the membranes of these bacteria are less sensitive to antibiotics to start with. What is serious about NDM-1 is that this enzyme mutation renders these bacteria insensitive to commonly available antibiotics. Cases have been detected in India, Pakistan, the UK and other locations. See attached the breakthrough article in the Lancet from 2010.

What I find somewhat alarming is that this is being dealt with almost entirely as a medical problem centering on improper use of antibiotics. And the first line solutions remain to be more sophisticated antibiotics. But these are not forthcoming and probably won't be for at least 10 years, if ever. **An integrated preventative approach involving water, sanitation and hygiene experts and practitioners has still yet to be initiated. Containment of faeces and reduction of associated pathogens should be the top priority for all cities at risk. Waterborne sanitation systems were never designed to eliminate these sorts of superbacteria and now that they are even turning up in the chlorinated water supply system we can see what sort of monster this can develop into.**

News this month from Hongkong indicate that mainland China is now a source of these mutated E. coli as well. www.scmp.com/news/hong-kong/article/1084...e-fourfold-hong-kong

For more reading see the additional 2 attachments.

Arno Rosemarin/SEI

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by JK Makowka - 03 Dec 2012 06:47

Hmm, if this is already wide spread in the general population it will be very difficult to contain... however most likely improved hospital sewerage treatment might lessen the problem.

Antibiotic resistant bacteria might well turn into one of the major burdens of the 21st century, just good hygiene will probably not solve that problem as the genes for that are transferred horizontally between bacteria species. Add to that, that many potential pathogens are opportunistic, e.g. might live with you for an extended period of time, on your skin or in your guts without ever causing trouble, but "activate" once your immune system is weakened. If you are then treated with an antibiotic you are actually helping those resistant strains to multiply without competition, which is a recipe for disaster.

Good personal hygiene will help somewhat, but you always have these bacteria on your skin and in your guts, in fact removing them would make you ill.

So these resistant bacteria really have to be dealt with in a way that they never even develop, as once the resistance giving plasmids are out in the wild it's almost impossible to get rid of them again.

So how can this be done? Well these resistances develop where antibiotics are administered to patients, mostly in hospitals (but also in ambulant and self medicating patients, as well as in industrial livestock farming), and the only way to really stop this from happening (given you still treat the patients) is to have an effective mix of antibiotics to make sure one of them finishes off the bacteria that might have become resistant to the others.

So to conclude... improved hygiene and especially treatment of hospital wastes might lessen the problem somewhat, but it really needs to be dealt with at the source! That however can only be done by strictly regulating the use of antibiotics and developing new and improved ones that are still effective.

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by sjoerdnienhuys - 16 Dec 2012 10:10

It seems also an argumant to minimise waterborn sewage system and focus on well functioning UDDT systems.

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by KeithBell - 30 Dec 2013 05:35

Here is a new study about effects on microbial ecosystems by drinking water treatment.

www.nature.com/srep/2013/131219/srep0355...;utm_campaign=Buffer

Interesting about alphaproteobacteria as that's the type found predominant in brain microbiome per one study. Or, do you believe your brain is sterile . . . and did you know chlorine raises cholesterol? Ask champion swimmer, Mark Spitz. **Wastewater and drinking water treatment appear akin to deforestation, permanently altering 'old growth' ecosystems.**

Please see here:

'Superbugs' Found Breeding in Sewage Plants'

www.sciencedaily.com/releases/2013/12/131216142807.htm

www.scientificamerican.com/article.cfm?...lants-super-bacteria

www.sciencedaily.com/releases/2011/12/111207133042.htm

www.ncbi.nlm.nih.gov/pubmed/20112862

www.medscape.com/viewarticle/756378_8

www.sciencedirect.com/science/article/pii/S0043135402005699

www.formatex.info/microbiology2/509-519.pdf

www.ingentaconnect.com/content/tandf/bes...41/00000003/art00002

onlinelibrary.wiley.com/doi/10.1111/j.15...41.2005.00032.x/full

'These results demonstrate that final effluents from wastewater treatment plants are potential reservoirs of various antibiotics resistance genes.'

www.biomedcentral.com/1471-2180/10/143

www.sciencedirect.com/science/article/pii/S0944501309001153

www.pbs.org/wgbh/pages/frontline/hunting...-nightmare-bacteria/

blogs.wsj.com/indiarealtime/2013/04/23/i...s-lost-superbug-war/

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by KeithBell - 30 Dec 2013 20:02

Available data show significantly higher proportion of antibiotic resistant bacteria contained in raw and treated wastewater relative to surface water. According to these studies, the conditions in wastewater treatment plants (WWTPs) are favourable for the proliferation of ARB.

www.sciencedirect.com/science/article/pii/S0147651313000328

We also found significant differences with respect to community structure and composition between upstream and downstream samples. Therefore, our results indicate that WWTP discharges may contribute to the spread of ARGs into the environment and may also impact on the bacterial communities of the receiving river.

www.plosone.org/article/info%3Adoi%2F10....06#pone-0078906-g003

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by JKMakowka - 30 Dec 2013 21:23

I am starting to think those studies are funded by membrane and UV-disinfection equipment producers to cause a public outcry and force municipalities to buy these very expensive upgrades...

Not because I would disagree that antibiotic-resistant "super-bugs" are a huge problem (they are!), but because they consistently try to shift the focus to the WWTPs, while the main issue is clearly upstream of them.

But I guess the simpler explanation is that sanitation researchers tend to focus on sanitation infrastructure ●

Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by KeithBell - 31 Dec 2013 05:24

You may be missing the point, JK, which is that wastewater treatment plants are actually multiplying the problem.

www.sciencedaily.com/releases/2013/12/131216142807.htm

Similarly, some people may believe the **polio virus** found in wastewater treatment plants is part of vaccination industry scare tactics. I'm not one of those people.

www.haaretz.com/news/national/.premium-1.546081

www.nation.com.pk/karachi/31-Dec-2013/83...rted-across-pakistan

www.nbcnews.com/health/polio-strain-syri...-confirms-2D11577484

www.nytimes.com/2013/01/24/health/egypt-...n-cairos-sewers.html

blog.psiimpact.com/2013/11/daily-impact-...io-vaccine-campaign/

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by JKMakowka - 31 Dec 2013 07:13

I got that point very well, and I agree it sounds scary. But I had a look at pretty much every publication about this that you posted and if you look at the actual data and the less sensationalists conclusions the scientists are drawing themselves, it all seems much less of an issue.

The conclusions so far seem to be:

1. WWTPs are not an environment where anti-biotic resistance is created, thus the real problem is upstream of them and WWTPs are rather the place where this is most often observed/tested.

2. There seems to be some evidence that the conditions inside a WWTPs can lead to an relative (!) increase in bacteria containing certain resistance genes compared to the inflow and that WWTPs in

general do not completely or sufficiently remove bacteria that contain these genes. However note that an relative increase does not mean that the bacteria are multiplied, and it also seems to be not a positive selection specifically for the resistance, but rather that certain types of bacterial grow better in WWTPs that also happen to contain resistance genes more often.

3. There is this one paper you linked an article about above that seems to suggest that they actually measured an absolute increase, but I can't access the full original publication (Uganda seems to be blocked completely by that publisher) and the sensationalist writing that actually gets quite a few things wrong (for example NDM-1 protects the bacteria only against one family of antibiotics, which is one that is commonly used, but by far not the only one and treatment is still possible) and that quotations seem suspiciously out of context makes me suspect that the original article might have been misinterpreted. (Edit: I read another news article about this, which already made it sound much less severe: only one of the two WWTPs had a higher release and it is unclear if those are viable bacteria after the chlorination step. It also mentioned that the authors of that paper are also working on a improved waste water disinfection process...)

I agree that this entire topic is something that needs to be looked into further, and it certainly warrants specific measures to be taken in decentralized WWTPs of hospitals (which is nothing new), but mainly focusing on this issue which seems of relatively minor importance in the bigger picture of the wide spread increase in multi-drug resistant pathogenic bacteria is counter productive as it tries to eliminate symptoms far from the original cause.

P.S.: having worked in Pakistan, which is one of the last countries with endemic polio, and having seen the horrible effects and how people are rallying against vaccination for ideological reasons, I would be the absolute last to talk about "scare tactics" in relation to polio.

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by KeithBell - 31 Dec 2013 08:06

In one wastewater treatment plant, we had four to five of these superbugs coming out for every one that came in.

That sounds like a measured increase to me.

www.sciencedaily.com/releases/2013/12/131216142807.htm

Furthermore, and I never say furthermore, a mechanism by which superbugs are **created** in WWTP is **horizontal gene transfer**

www.plosone.org/article/info%3Adoi%2F10....journal.pone.0078906

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by JK Makowka - 31 Dec 2013 08:44

Yes that single article sounds like they measured an absolute increase (as mentioned above), but they didn't even measure "superbugs" but concentrations of DNA through quantitative PCR. Thus I am skeptical regarding the implications.

Concerning horizontal gene transfer: yes that can happen in WWTPs, but it is not MORE likely to happen there according to the literature I have seen so far. In general it seems like the physio-chemical properties of untreated sewerage and bio-films of fecal bacteria seem to slightly favor this, but it still needs a selection pressure to actually result in an increase in resistance gene harboring bacteria. This however is not the case in WWTPs (concentrations of antibiotics are too low) or at least not more so than elsewhere along the sanitation chain.

Edit: Can we agree that miss-using antibiotics and then flushing it all down the drain is a bad idea, instead of playing a blame game and pointing fingers at WWTPs which are really at most a minor factor in this?

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by KeithBell - 31 Dec 2013 16:39

Of course, I agree antibiotic abuse is likely the main issue, perhaps especially in livestock which humans eat. But we also should not downplay the role of WWTP as there is plenty of selection pressure, the nature of the beast. Chlorine itself selects out resistant spore-forming gram-negative bacteria which are the main group implicated in antibiotic resistance.

The same issue of concern takes place in **anaerobic digesters** (AD), technology poised for explosive growth here in the USA. Perhaps you've already discussed AD somewhere on this forum. Livestock waste especially may be a problem in creating superbugs such as pathogenic clostridium said to have destroyed dairy farms in Germany.

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Re: Mutated Entero Superbugs Being Spread in India's Sewage and Water Supply

Posted by muench - 03 Jan 2014 01:18

I am glad that a small consensus has been reached now as you wrote:

Of course, I agree antibiotic abuse is likely the main issue, perhaps especially in livestock which humans eat.

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About anaerobic digesters and the mentioned link to dairy farms in Germany ("rise in botulism cases"), you might find this thread on the forum interesting where Ralf Otterpohl and Heinz-Peter Mang discussed this in 2011/2012 (I do have a good memory •

forum.susana.org/forum/categories/35-bio...o-biogas-plants#1630

Further discussion could take place under that thread if you like.

Cheers,

Elisabeth
