A BUG'S LIFE – SO SIMPLE, AND YET SO FASCINATING TOO

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The Basics are the Most Important – They are Easy!

Hand Hygiene

Hand hygiene is the single most important way to prevent the spread of bugs. Always think of your hands as contaminated until you have just washed or alcohol hand rub cleansed them. Cleanse before and after touching patients or their environs, after going to the toilet, before preparing food and refrain from touching your face, mouth or nose – there is a risk to you (viruses going into your mucosal surface) and a risk to patients (eg influenza virus shed a day before your symptoms begin). Commonly touched surfaces pose risks, eg knobs on anaesthetic apparatus, tubing, handled packages, bed rails, door handles, keypads, tap handles, pens, reception desks, waiting room chair arms and magazines, may all carry potentially harmful bugs. Normal skin carries 1,000 to 10,000 bacteria per square cm, 30% more under rings. Faeces contains a million million bacteria per gram, but 1,000 times more if virus is present (eg Norovirus). We only need to ingest 3-10 Norovirus to catch infection, or pass it on. It is a 'sticky' virus, harder to wash off than most, and partially resistant to alcohol rubs. Clostridium difficile is resistant to alcohol hand rubs (because of spores). Most other bugs are susceptible to alcohol disinfection. Contact precautions (gloves, gowns) should be used for direct or indirect contact of any biological fluids, or skin contact especially is the presence of known or likely MDRO (eg MRSA, ESBL, VRE).

Coughing

Coughing is the next most important way to spread bugs, especially colds, flu and other respiratory viruses. So cover your cough – cough into an elbow or tissue. Don't cough into and contaminate your clean hands with millions of viruses! Stay at home if you are ill. Wear a mask to keep cough droplets containing bugs in, or out, when appropriate. Treat masks as extremely infectious once worn – they are there to filter, and so concentrate any bugs in the air onto the mask surface. Use droplet precautions (mask, facemask, gown) for any respiratory virus, aerosol producing procedures, Bordetella, N. meningitides, or outbreak causing infections. Use airborne precautions (full PPE) for TB, measles, chicken pox, the immunecompromised.

Environment

Bugs generally require moisture, warmth and nutrients to survive and multiply. Most bugs die in the dry in a few hours to days – respiratory viruses generally within minutes, bacteria generally within hours to days. Walls floors and ceilings are not usually the risk (not wet) – it is us and our habits that are highest risk.

Good Bugs vs Bad Bugs?

Large numbers of almost any bugs can cause infections if in the wrong place. Think of the bugs in fresh pasteurised milk – harmless to drink and they probably help boost our immune system each time we drink (like when we breathe). However if the same bugs are present in large numbers as when the milk ages or 'goes off' they become nasty pathogens. Vulnerable people / patients are infected / affected by lower numbers of bugs. Low numbers of any bugs on compromised tissue or any foreign material (eg IV lines, prosthetic devices) rapidly form biofilms which are impenetrable to natural immunity and antibiotics, and become seats for infection.

We Need to Control the Numbers and Stop the Spread of Bugs

We live in a microbial world, not a sterile world. We have to learn to understand and manage the microbes or bugs / germs in and on us, and in our environment, to our best advantage. Hand washing does not sterilise our hands but if done thoroughly it removes any relatively newly arrived potential pathogens – the transient bacteria. The resident bacteria remain to help protect us (about 1,000 to 10,000 per cm^2) but like milk bottle bugs can cause problems if too many are in the wrong (wet) place, eg IV lines, wounds, dermatitis, food.

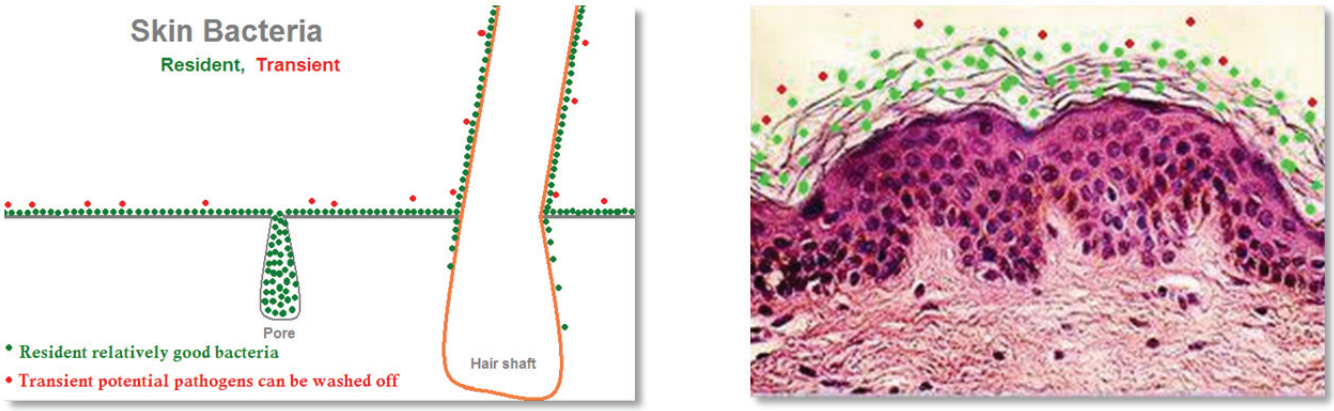


Figure 1. Normal skin cross section with 'bugs' added ●●●●

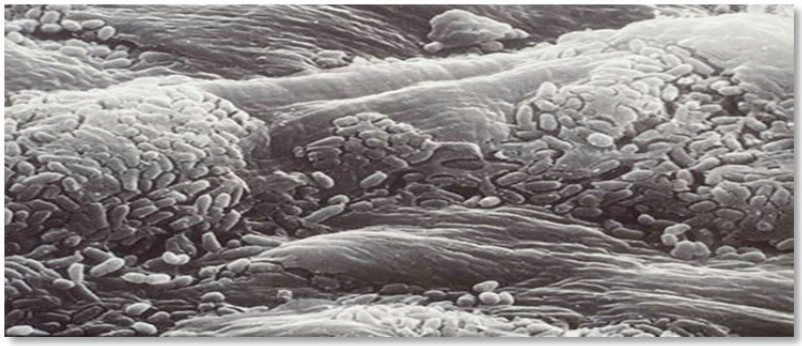


Figure 2. Skin surface with resident bacteria

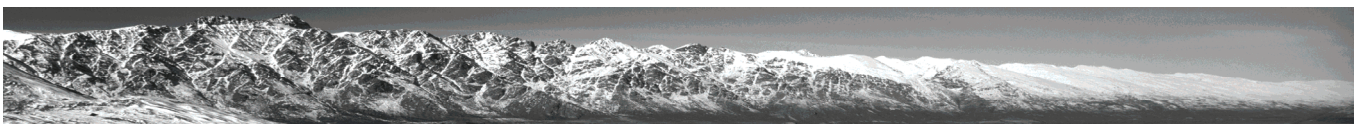
Infection prevention, and when this fails, infection control, are based on simple, common sense principles. These principles are based on science, written in procedures and protocols for us to implement. But a combination of our lack of knowledge or understanding combined with our habits of a lifetime overlaid by our more complex attitudes, behaviours and workplace culture can serve to make the implementation of these simple principles an on-going challenge.

We risk making our understanding of infection prevention more complex than we need to, perhaps similar to Churchill's comment on Russia –

"It is a riddle, wrapped in a mystery, inside an enigma; but perhaps there is a key. That key is Russian national interest"

And ours is good health by good hygiene practices, for all of our sakes.

It is likely at least 70% of cross infections are relatively easily preventable – yet even common colds, influenza, norovirus and food poisonings are on-going reminders of how much and far our individual and combined behaviours fall short. Good hand hygiene and respiratory etiquette are top of the list. We have improvements to make – and to do this we need to better understand ourselves and others before we can effect these changes.



We generally know what to do, but we collectively need to change our current ways or habits to make sure we do it, or do it better than we are now.

Bugs are fascinating (except perhaps their names!) – very simple in some ways and in their requirements to survive (moisture, nutrients, warmth), but remarkably adaptable and also complex. We know a great deal about them but there are endless opportunities to discover more – their rapid reproduction allows rapid evolution from small genetic changes, their multiple abilities to resist antibiotics, their ability to form impenetrable biofilms, swap genetic material and antibiotic resistance secrets with their own and other species, and their ability to communicate amongst themselves multi lingually by chemical language 'quorum sensing' for their common greater good, and their altruism, can all be easily overlooked.

How Do We Catch Bugs?

We and patients catch most bacterial infections from ourselves (endogenous), a facilitated emergence of the normal flora adjacent to where the integrity of our tissues has been compromised (surgery, wounds) and / or foreign body material is present (IV lines, dead tissue). Staphylococcus aureus from our skin, anaerobes (eg Clostridium difficile), coliforms and streptococci from our GI tract.

Another source are the hands / habits of medical staff, and commonly touched / contaminated surfaces. Our skin is like a lawn with grass on it (cf Staph epidermidis), but with some weeds present (Staph aureus). Tear the surface of lawn turf and the nearby weed fills the gap, similarly Staph aureus in wounds.

The central line associated bacteraemia (CLAB) programme is essentially to prevent the emergence of the above conditions – prevent emergence of low numbers of S aureus (recognised pathogen), or even high number of usually low pathogenicity Staph epidermidis – usually normal flora but in high numbers when facilitated by biofilms along a foreign body (IV line) can gain entry to the bloodstream.

Other bugs are not usually in or on us (exogenous) – viruses, many food poisoning bugs, some bacteria (eg TB or Cl difficile spores in the theatre / ward environment).

Antibiotic Resistant Organisms – How to Prevent Their Development and Spread

The WHO has identified emerging antibiotic resistance as one of the three major challenges facing mankind (along with food and water). Antibiotics are believed to give us on average an extra 10 years of life.

How do bacteria become resistant – we selectively breed them for resistance!

Every time we use an antibiotic (from this amazing, but limited resource) we kill the susceptible bacteria only (both the intended pathogens but also the unintended 'good' bacteria) but not those bacteria that are resistant – these then multiply, swap the genetic material conferring resistance, and keep emerging wherever and whenever we use antibiotics most, ie hospitals, ICUs, LTCFs. Overall the bacteria at these sites, both on our patients and us (we share the same bugs) become increasingly resistant. Hence the emergence of MRSA, ESBL. VRE, etc.

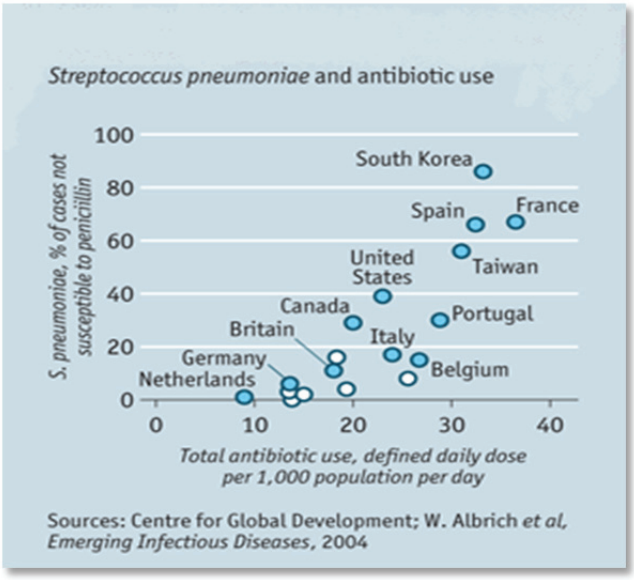
Routine practices including good hand sanitation with contact precautions are important strategies in preventing the spread of antibiotic-resistant organisms. However judicious antibiotic use is a critical measure to prevent their development in the first place. All antibiotic management should be evidence based and we should strongly resist the temptation to succumb to patient or clinician pressure to use them when they are not beneficial and are in fact detrimental to not only their but also the community's future health.

The sooner we use up this limited, valuable resource of antibiotics the sooner we will lose it.

'No action today, no cure tomorrow' – WHO antibiotic reduction catchphrase.

MRSA is primarily found in the nose and on the skin and can cause associated site infections. The primary reservoir of ESBL and VRE is the bowel and can cause UTI and wound infections.

A)



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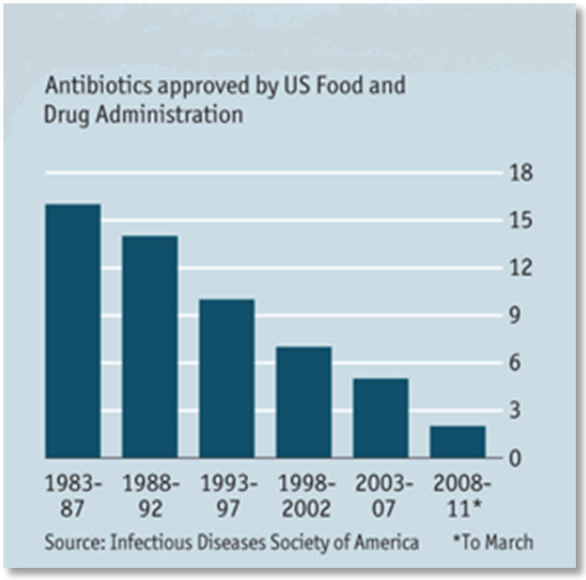


Figure 3. A) The link between antibiotic usage and resistance. B) New antibiotics being developed

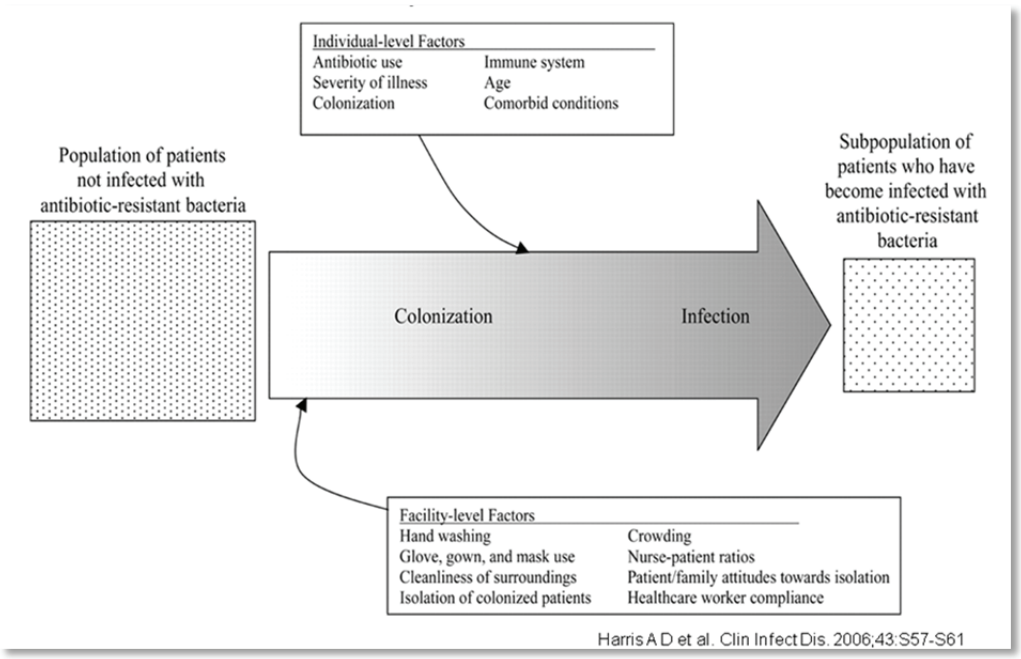
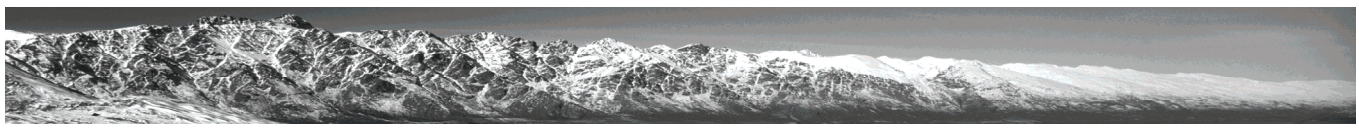


Figure 4. Factors that influence the acquisition of antibiotic-resistant bacterial infections

Total antibiotics used –

- 30% for human use
  - of which almost 100% is for treatment, 80% community, 20% hospitals (concentrated use)
- 70% for
  - Agriculture – caged poultry, pigs, plus Northern Hemisphere winter housed animals
    - 80% prophylaxis (added to routine feed), 20% for infection treatment
  - Horticulture – fruit sprays, kiwifruit PSA, etc
  - Aquaculture – fish farms, shrimp farms – routinely added to water

New Zealand is a low use antibiotic country, but still used 80 tons of antibiotics for non-medical use in the year 2000, the last year for which data is available. We import food from around the world, sell food (resistance) in supermarkets, travel widely and have many tourists – all sharing bugs and resistance liberally.



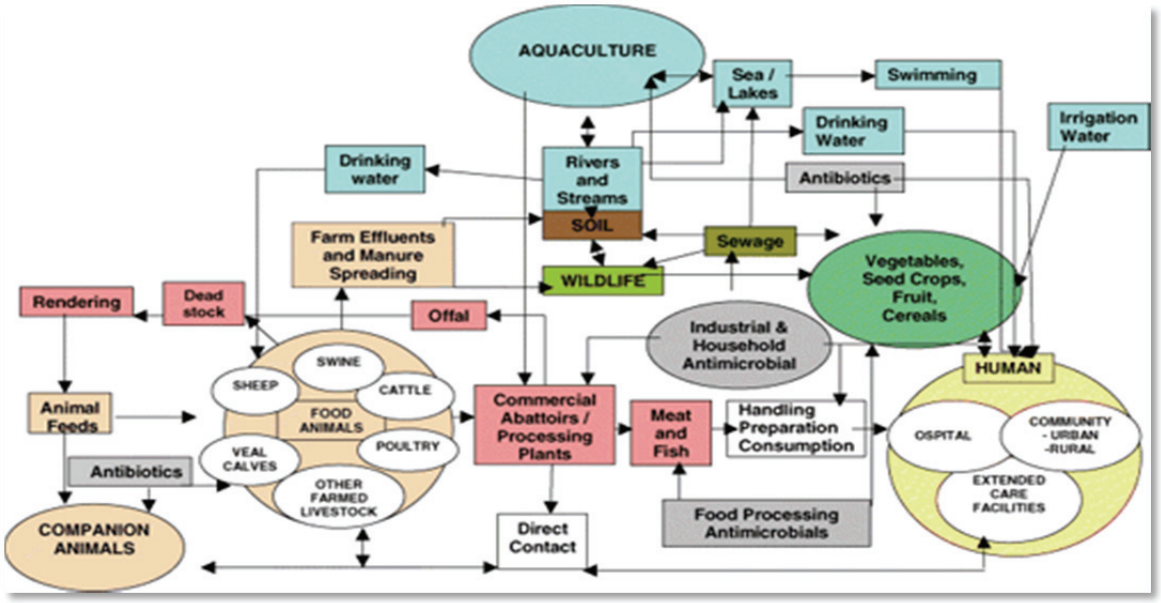


Figure 5. The spread of microbes

Infection Control References

- A-Z of health topics for the profession and patients – www.cdc.gov
- Profession resource – www.shea-online.org/guidelinesresources/guidelines
- Patient flyers for MRSA, VRE, Cl difficile, etc - www.shea-online.org/forpatients
- www.infectioncontroltoday.com