Microbe of the month

Breaking The Chain of Infection

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Newsletter

Compiled by Helen Loudon, Independent IPC Practitioner

Featured this month:

MDRO's

Multidrug-resistant microorganisms

Hello readers!

We are only just beginning to conceive of the formidable and far-reaching impact of antimicrobial resistance. Multidrug-resistant microorganisms (MDRO's), such as MRSA (methicillin-resistant Staphylococcus aureus) and MDR-TB are now also prevalent in the community, while local surveillance has also identified worryingly high levels of stool carriage of extended spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae* in patients being admitted to ICU's around South Africa.

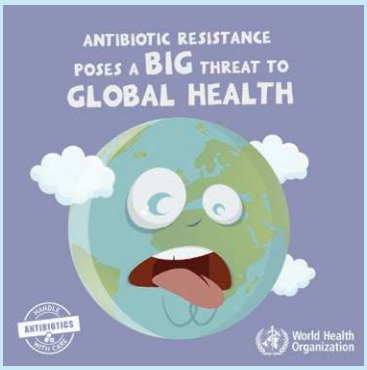
***The Enterobacteriaceae are a large family of Gram-negative bacteria that includes E. coli, Klebsiella pneumoniae, Citrobacter and Salmonella.**

Beta-lactamase is an enzyme produced by many species of bacteria in response to the 'selective pressure' associated with overuse of antibiotics. Beta-lactamase damages the molecular structure (known as the 'beta-lactam ring') of the beta-lactam class of antibiotics, making them useless. This includes all the **penicillin** derived antibiotics, **cephalosporins**, **monobactams**, and **carbapenems**. When a plasmid carrying the genetic material for antibiotic resistance is inserted into other bacteria, antibiotic resistance can spread easily and quickly among bacteria. Additionally, if a bacterium's genetic material spontaneously mutates, those genetic changes can also create resistance.

Antimicrobial resistance rates are highest in ICU's because of antibiotic overuse, imperfect isolation practices, and prolonged stays of patients who are highly-susceptible to nosocomial infections because of comorbidities and the use of indwelling devices, such as endotracheal and nasogastric tubes, urinary catheters, and central venous catheters.

The spread of resistant organisms to geographically-distant regions has added further momentum to the explosive rise in antibiotic resistance in recent years. The global spread of antimicrobial resistance is fuelled by poor hygiene and common use of over-the-counter antibiotics in developing countries, veterinary practices that overuse antibiotics, and the frequency of international travel.

The rise of resistant infections in the community puts more people at risk, makes spread more difficult to identify and contain, and threatens the progress we have made to protect vulnerable patients in healthcare.



What is the difference between antibiotic and antimicrobial resistance?
Antibiotic resistance occurs when bacteria change in response to the use of antibiotics used to treat **bacterial infections** (such as urinary tract infections, pneumonia and bloodstream infections) making them ineffective.

Antimicrobial resistance is a broader term, encompassing resistance to drugs that treat infections caused by other microbes as well, such as **parasites** (e.g., malaria or helminths), **viruses** (e.g., HIV) and **fungi** (e.g., Candida).[1]

Antimicrobial resistance is an ancient phenomenon!
Selection and survival of the "fittest" (i.e., natural selection) is a fundamental principle of life and evolution – however, there is a well-established relationship between inappropriate antibiotic prescribing practices and the emergence of resistant microorganisms.

This is termed '*acquired resistance*' and is influenced and exacerbated by the **misuse and overuse** of antimicrobial agents through a process of '*selective pressure*'.
Using antibiotics to treat viral infections such as colds or 'flu, sharing antibiotics, low quality generic drugs and poor infection control practices also encourage the development and spread of drug resistance.

What is meant by the term multidrug-resistant organism?

Multidrug-resistant organisms (MDRO's) are labelled as such because of their ***in vitro*** resistance to more than one antimicrobial agent. Infections with MDRO's can lead to inadequate or delayed antimicrobial therapy, and are associated with poorer patient outcomes.

Many different definitions[2] for multidrug resistance (MDR), extensive drug resistance (XDR) and pan-drug resistance (PDR) are being used in medical literature to characterise the different patterns of resistance found in antimicrobial-resistant pathogens; however, the following has been proposed:

- **MDR** is defined as non-susceptibility to at least one agent in three or more antimicrobial categories.
- **XDR** is defined as non-susceptibility to at least one agent in all but two or fewer antimicrobial categories (i.e., bacterial isolates remain susceptible to only one or two categories).
- **PDR** is defined as non-susceptibility to all agents in all antimicrobial categories (i.e., no agents tested as susceptible for that organism).

Clinical relevance?
Bacteria that are pan-drug-resistant carry the most absolute type of antimicrobial resistance possible, implying that there are no approved antimicrobial agents that have activity against these strains.

Characteristics of MDRO's

MDRO's have a few characteristics in common - they possess the ability to: colonise humans and animals because of specific virulence factors (e.g., special cell capsules, biofilm and exotoxin production to name a few); cause serious illness; survive for extended periods on, inside and around people; and easily be transferred from one person to another via direct, indirect or inanimate contact. Their resistance mechanisms are often stable, so their survival potential is unaffected.

Clinical relevance?
Of the MDRO's, highly-resistant Gram-negative bacteria (also referred to as GNB, e.g., multidrug-resistant carbapenemase-producing Klebsiella *pneumoniae* and Acinetobacter species) require special mention. These organisms can be resistant to all currently available antimicrobial agents or remain susceptible only to older, potentially more toxic agents such as the polymyxins (e.g., 'Colistin®'), leaving very limited and sub-optimal choices for treatment.

KEY STRATEGIES FOR THE CONTROL OF MDRO's

MDRO prevention measures generally fall into 2 categories:

- **Control of transmission**
- **Antimicrobial stewardship**

Transmission control is focused on preventing the spread of clinically-significant pathogens, principally via the contaminated hands of healthcare workers (HCW's) and the environment (particularly contaminated surfaces and equipment). Although hand hygiene is the cornerstone of transmission control, additional measures are necessary for many serious healthcare-associated pathogens. Many studies have demonstrated a potentially important role for the transmission of MDRO's via **contaminated antiseptics and sources of moisture, inanimate objects and environmental surfaces**, including the **clothing** and personal equipment of HCW's such as **pagers** and **cellphones**.

Clinical relevance?

Common reservoirs for Gram-negative microbes in hospitals are those constantly or intermittently exposed to water. This includes hand-wash basins, sinks, sluices, showers, baths and toilets. Bacterial biofilm builds up in plumbing components, including taps, water filters and sink traps underneath water outlets. Biofilms host and protect a multitude of water-loving organisms and pose a threat to nearby debilitated patients.

Additionally, bacteria within biofilm display greater capacity for antimicrobial resistance while tolerating chlorine and other disinfectants.

Healthcare-associated pathogens such as Acinetobacter, vancomycin-resistant Enterococci (VRE) and C. *difficile* (spores) have been found to **persist for months on inanimate surfaces**. (A study utilising electron microscopy of common hospital sites reported the presence of biofilm capable of offering protection for a range of multidrug-resistant bacteria on dry surfaces.)

Gram-negative pathogens seem to survive longer on inanimate objects than on hands, although they have been shown to be carried persistently on the hands of 21% of HCW's. Wearing artificial fingernails has also been shown to increase the risk of carriage of Gram-negative organisms among HCW's.[6]

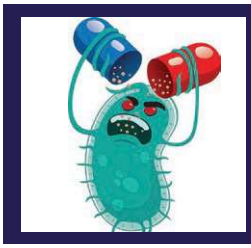
Antimicrobial stewardship complements transmission prevention as a tool for MDRO control. Most importantly, it is widely recognised that antibiotic use – particularly misuse and abuse – is the primary trigger for the emergence of antimicrobial resistance. Conservative estimates are that at least one third of patients admitted to the hospital will be treated with a course of antibiotics. Furthermore, many opportunities for inappropriate antibiotic therapy exist – one study documented antibiotic misuse in 37.4% of hospital prescriptions.[6]

Clinical relevance?

The effect of antimicrobial exposure does not only affect the individual taking the drug, but has also been shown to increase the risk of MDRO colonisation amongst close contacts. By addressing these issues, stewardship programmes that promote judicious antimicrobial use can have a major effect on MDRO control.

Once MDRO's are introduced into a healthcare setting, transmission and persistence of the resistant strain is determined by the availability of vulnerable patients, selective pressure exerted by antimicrobial use, increased potential for transmission from larger numbers of colonised or infected patients (termed "colonisation pressure") and the impact of adherence to appropriate infection prevention efforts.

Patient risk profile	Site/s commonly found	Microorganisms implicated
• Regular hospitalisation • Gyms, boarding schools, prisons • Frail care / long-term units • Wound clinics • HIV, renal dialysis, ICU • Diabetes • COPD, corticosteroid Rx, malignancy • Stoma / urostomy / catheter	Skin, hands & nares, clothing, linen Sputum Urine Chronic wounds (e.g., pressure injury, lower limb & diabetic foot ulcers)	• **Staphylococcus *aureus* / MRSA** • **Enterococci & VRE** • **Pseudomonas *aeruginosa*** • **E. *coli*** • **Klebsiella species** • **Acinetobacter species**
COPD, diabetes, malignancy, corticosteroid Rx, HIV, wound clinics	Skin, oropharynx, GIT, urine, chronic wounds	**Candida species** (spores)
Frail aged, ICU, broad-spectrum antibiotic therapy	Deep wounds, skin and patient surfaces after faecal soiling	**Clostridiodes *difficile*** (spores)



Every infection prevented is one that needs no treatment!

The road between the community and the hospital runs both ways. There are ample opportunities for the transmission of MDRO's beyond the hospital setting, when patients receive care at multiple healthcare facilities and move between acute care hospitals, out-patient, frail aged and long-term care environments.

THE ROLE OF ANIMALS AND THE ENVIRONMENT IN DRIVING THE TRANSMISSION OF RESISTANCE

Antibiotic use in animals affects humans too...

Antibiotics are used extensively in veterinary medicine and agriculture (to treat and prevent infections and as growth promoters), creating additional reservoirs of antibiotic-resistant microbes that may infect humans.

The mechanisms of resistance are indistinguishable between bacteria isolated from animals and human beings. Bacteria – and those mobile genetic elements which may confer resistance – linger on animal skin and in faeces, and can be transferred to human beings and vice versa.

This intermingling of animal and human microbial ecosystems extends to both commensals and opportunistic pathogens, including bacterial species such as E. *coli*, enterococci, and Staphylococcus *aureus* (including MRSA).

The role of sewage and waste processing in environment-to-human transmission is also clear. Antimicrobials and antimicrobial metabolites enter waterways not only from human waste processing, but also from **pharmaceutical industry pollution**.

As a result, many potentially-pathogenic antimicrobial-resistant microbes have been isolated from pre-treatment and (importantly) post-treatment sewage systems.

In summary, the worldwide acquisition, persistence and transmission of antimicrobial-resistant microbes by people, animals and the environment is hugely affected by factors such as: no access to clean water; overcrowding; open rather than closed sewage systems; variations in healthcare infection control practices; inappropriate use of antimicrobial agents across healthcare, veterinary and farming systems; and high population densities.

SHOULD WE BE CONCERNED ABOUT THE PART AIR TRAVEL PLAYS IN SPREADING INFECTIOUS DISEASES AND MDRO's?

Low airfares and a series of social and economic factors have made global air travel more common than ever – the International Air Transport Association (IATA) projects passenger demand will reach 8.2 billion by 2037.[7] One study estimates that over 300 million travellers visit high-risk areas (such as the Western Pacific, Middle East, Southeast Asia and Eastern Mediterranean) each year worldwide, and **more than 20% return as new carriers of resistant organisms.** [7]

Aircraft move large volumes of people around the world swiftly. But what sets them apart from busses and trains is that passengers are close together, in confined spaces, for a long time. This increases the risk of transmitting infections.

Think about it – air passengers interact with high-touch surfaces, such as tray tables, headsets, seats and handles.

They cough, sneeze and touch multiple surfaces multiple times during a flight, with limited opportunities to clean their hands with soap and water.

There are many examples of infectious diseases spread via international flights – pulmonary TB, influenza, gastroenteritis, the carbapenem-resistant NDM-1 strain of Klebsiella pneumoniae isolated from a Swedish patient after a hospital stay in New Delhi, India in 2008, and the fungal super-bug Candida auris (refer to MOM October 2019).

It would therefore seem very important to provide people with relevant infection control and health advice to limit the spread of infectious diseases via air travel. Information and advice on routine hand-washing with soap and water, or the use of alcohol-based hand rubs, and other basic measures including cough etiquette – such as coughing into your elbow and covering your nose and face – should be covered in the in-flight magazine, via the airline website and by travel agencies.

LESSONS LEARNED TO REDUCE THE INCIDENCE AND SPREAD OF MDRO's [1,3,4,5,6]

1. **Management support –**
   - Prompt and effective communication systems are essential, e.g., computer alerts to identify patients previously known to be colonised / infected with MDRO's
   - Maintaining staffing levels appropriate to the intensity of care required
   - Providing the necessary number and correct placement of hand-washing sinks and alcohol-based hand rub dispensers in the facility
   - Provision of skilled infection control personnel to implement, supervise and enforce adherence to recommended infection control practices (e.g., hand hygiene, Standard and Contact Precautions) and patient placement (isolation) for MDRO control

2. **Education** – formal and informal educational interventions (especially during orientation) to encourage behavioural change through improved understanding of the specific MDRO that the facility is trying to control.

3. **Judicious use of antimicrobial agents** – applicable to all healthcare settings – implement strategies for influencing antimicrobial prescribing patterns and education on antimicrobial stewardship principles, e.g., the use of narrow-spectrum agents, treatment of confirmed infections and not contaminants, avoiding excessive duration of therapy, and restricting the use of broad-spectrum or more potent antimicrobials to treat serious infections when the pathogen is not known or when other effective agents are unavailable.

4. **MDRO surveillance** – surveillance is a critically-important component of any MDRO control programme. Laboratory confirmation and antimicrobial susceptibility reports assist with the detection of newly-emerging pathogens, the monitoring of epidemiologic trends, and measurement of the effectiveness of MDRO interventions.

5. **Environmental measures** – the potential role of environmental reservoirs, such as surfaces and medical equipment, in the transmission of MDRO's has been well-documented. Interventions should include the use of dedicated non-critical medical equipment for patients known to be infected or colonised with an MDRO, correct handling and disposal of used linen and healthcare risk waste, and the assignment of dedicated cleaning personnel to the affected unit, with increased cleaning and disinfection of frequently-touched surfaces (e.g., bedrails, charts, lockers and over-bed tables, bathroom fixtures, switches, doorknobs, etc.) and those in close proximity to the patient.

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18th February 2020	**ANTIMICROBIAL RESISTANCE – A GLOBAL ONE HEALTH CHALLENGE** Speaker: Prof. Séamus Fanning, University College Dublin, Ireland

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REFERENCES

1. World Health Organisation (WHO) 2017. Antimicrobial Resistance – Key facts. Available from http://www.who.int/antimicrobial-resistance/en/ [Accessed 14.1.2020] **2.** Magiorakos, A.P., Srinivasan, A. et al. (2012) Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clinical Microbiology and Infection, Volume 18, Issue 3, 268 – 281. **3.** Multidrug-Resistant Gram-Negative Organisms (MDRGNO) Information for healthcare workers (2015). Journal of Hospital Infection 92 (2016) 92-94. **4.** Khan, A.S., Dancer, S.J., Humphreys, H. (2012) Priorities in the prevention and control of multidrug-resistant Enterobacteriaceae in hospitals. Journal of Hospital Infection 82 (2012) 85-93 **5.** Centers for Disease Control and Prevention (CDC)/HICPAC (2017) Updated Management of Multidrug-Resistant Organisms in Healthcare Settings. Available from: https://www.cdc.gov/infectioncontrol/guidelines/mdro/ [Accessed 14.1.2020] **6.** Courtney, H., Weber, SG. (2011) Common Approaches to the Control of Multidrug-resistant Organisms Other Than Methicillin-resistant Staphylococcus aureus (MRSA). Infect Dis Clin N Am 25 (2011) 181–200.**7.** Shaban, R.Z., Sotomayor-Castillo, C. (17th July 2019). Air travel spreads infections globally, but health advice from inflight magazines can limit that. The Conversation. Available from https://theconversation.com/air-travel-spreads-infections-globally-but-health-advice-from-inflight-magazines-can-limit-that-120283 [Accessed 14.1.2020]